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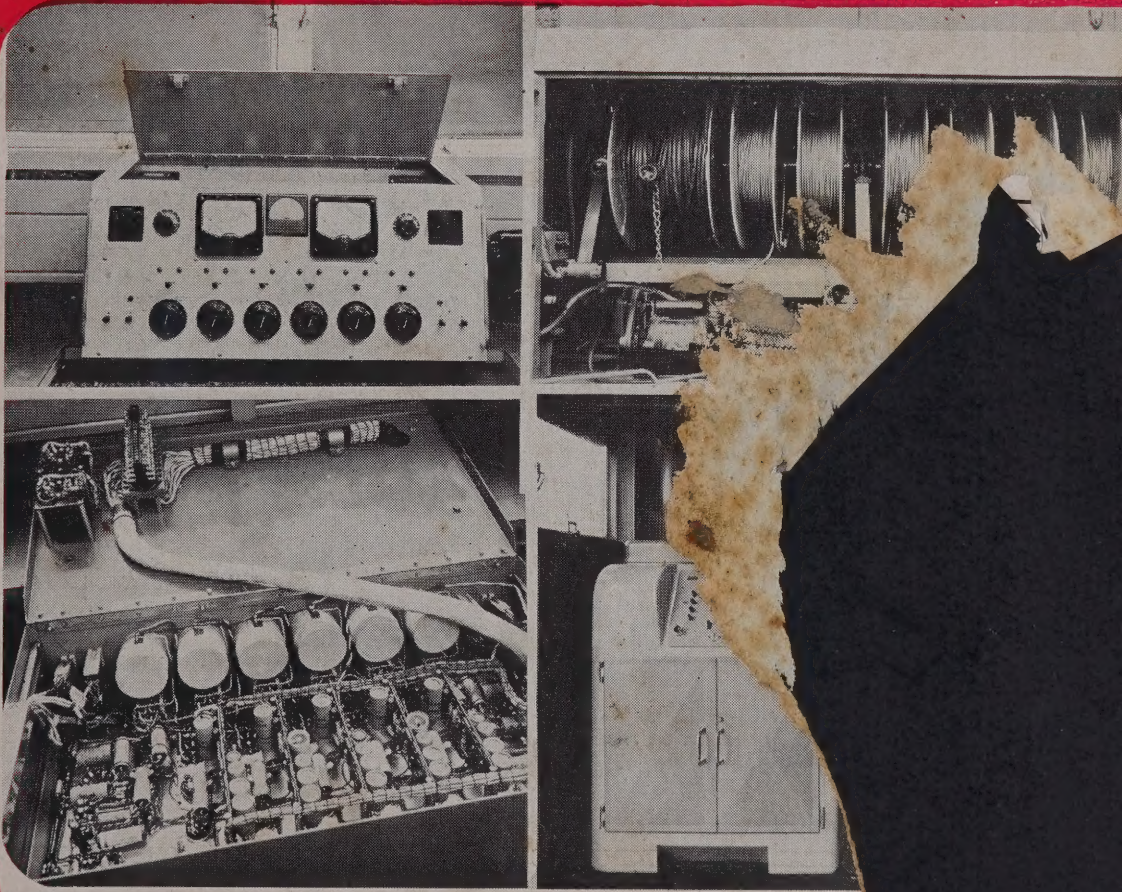

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OUR COVER

This month we feature some interior photographs of the N.Z.B.S. recording van described in last month's issue of "Radio and Electronics." Top left, we have the control console, at the back of the cabin. Underneath is shown the console, tilted forward to expose the "works," ready for servicing. Lower right is a view of the front end of the cabin, showing the two E.M.I. tape recorders. The fourth photograph shows the interior of the rear compartment of the van, showing the six reels of microphone cable, and the large reel of mains cable. Under the latter is the electric motor for power winding of the cables.

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Early Technical Training

A matter which is not unconnected with the development of our profession is the ever-present problem of the training of radio technicians. An advertisement in this issue of "Radio and Electronics" underlines the need for more trained men in our own field, and as far as we can see, very little is being done to provide them. Radio services are expanding at a very rapid rate, and it is particularly noteworthy that the latest Government Department to have developed a need for trained personnel has been obliged to import from the United Kingdom several engineers who are filling important and responsible posts. It goes without saying that if men of the requisite qualifications and professional standing had been available in this country, their services would have been made use of.

We do not number ourselves among those whose cry is for earlier and earlier specialization as an aid to vocational training. Indeed, with many others, we believe that the attempt to make boys decide, even before they reach secondary school, what trade or profession they will take up on leaving school is entirely wrong, and our own profession gives a first-class example of why this is so. Not only have young boys no idea at all of what the different occupations they may choose involve by way of training, but they also cannot possibly judge whether their aptitudes are suitable to the occupation which they may choose for themselves. Nor can decide that radio must be his life's work. So far, so good, but how is a boy, not yet at anyone else, for that matter. For instance, the lad who is attracted to radio as a hobby, may secondary school, to judge at what level of radio work he should aim? He may have the makings of a first-class engineer, and be fully capable of taking the engineering degree, or other qualification, whose course will enable him to become an engineer. On the other hand, he may be cut out for a service technician, for which the educational requirements are totally different, as are the needed skills and aptitudes. But since his schooling is to be specialized towards a radio career, he *must* know which of these occupations he will be most suited for, if his specialized training is to be at all successful. In short, too early specialization in a case like this is entirely wrong, and can more readily lead to a boy's being given the wrong training than the apparently more haphazard method of leaving specialization till later. The fact is, that at whatever level a boy may need to tackle the subject, once he is older, and his aptitudes have become more apparent, he needs the same basic training as the next one, who may need to approach the subject in an entirely different way *after a time*. The basis of radio remains mathematics and physics, irrespective of persons, so that everyone who is to be engaged in the subject needs the same basic training up to a point—a point which is far in advance of that at which the proponents of early specialization would have us believe. Carried to its logical conclusion, this rules out the usefulness of intermediate schools, and even to some extent, the necessity for different courses at technical and ordinary high schools.

Equalizing for L/P

In an article in last month's issue of "Radio and Electronics," the difference between ordinary 78 r.p.m. records and the new long-playing 33 1/3 r.p.m. ones was discussed, and some of the things that affect the user were briefly indicated. This article shows how standard types of pick-up can be equalized so as to give a flat frequency response on the new records.

INTRODUCTION

One of the most significant differences, as far as the user is concerned, between 78 and the new L/P records, is the entirely different frequency response. For the benefit of those who did not see the previous article, the response curves of the two types of record, as produced by the record companies today, are given again here, in Fig. 3. These curves are those that would be obtained by playing any of these records with what is called a constant-velocity pick-up. That is to say, a pick-up in which the voltage output is proportional to the velocity of movement of the stylus from side to side in the groove, rather than to the amplitude of this movement. All magnetic pick-ups belong to this classification, and, since the crystal pick-up requires entirely different treatment, we will confine this story, in the first instance, to the magnetic type.

It is not proposed to enter here into a discussion on the whys and wherefores of these response curves, because this has already been done several times in these pages, but rather to show how simple equalizing networks can be inserted in amplifiers or pre-amplifiers for the purpose of making the overall response of the pick-up and its record, flat, in the normal manner.

VARIOUS SCHEMES RECOMMENDED

Since the introduction of reasonably priced high-quality pick-ups for 78 r.p.m. records, and particularly since the introduction of L/P ones, quite numerous circuits have been recommended for equalizing the response of the record, the pick-up, or both. Unfortunately, a good many published circuits refer only to a particular pick-up, and so are of no assistance at all to one who has purchased a pick-up of another kind. However, it is necessary at the outset to distinguish between different types of pick-up, even among the magnetic class. For example, we said a moment ago that the response curves shown as being those of the record assumed that it was played with a pick-up which had a true constant-velocity characteristic. This means one whose response is proportional to stylus velocity *at all frequencies within the audible range.* Now such a pick-up would at one time have been looked upon as the theoretical ideal, unattainable in practice, but such is progress, that for a very few pounds (or dollars, if one possesses them) a pick-up can be purchased which answers to this description very closely—indeed, almost absolutely. One or two pick-ups of this kind are available here today, and are not unduly expensive at that. They are to be preferred, since their response can for all practical purposes be called flat. Thus, when any of these types are used on commercial records having characteristics as shown in Fig. 3, the overall response will be *exactly as in Fig.* 3. Any equalizing that is done now, in order to flatten the response can truly be said to be equalization for the characteristic of the record itself and not for the pick-up.

Other pick-ups, which conform in a general way to the constant-velocity description, do not conform exactly. For instance, one well-known make has a rising characteristic at frequencies above 1000 c/sec. If this pick-up were used with an amplifier which was compensated on the assumption that an ideal pick-up were to be used with it, the result would be a preponderance of high frequencies. This would occur on both 78 and L/P

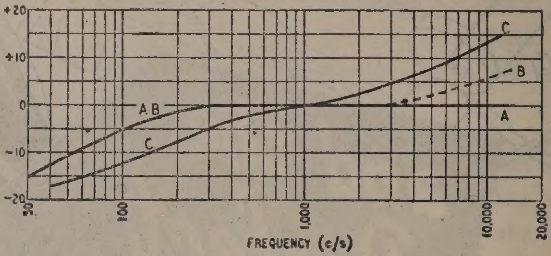


Fig. 2.—Frequency characteristic (A) standard 78 recordings, (B) Decca ffrr 78 records, and (C) Decca L/P recordings.

records, and is something that would have to be separately compensated, quite apart from any compensation that is needed, to take care of the characteristic curve of the record itself. As a rule, however, such departures from ideal behaviour are not very wide, or, if they are, are easily compensated, usually by means of a special circuit recommended by the maker. So that if one buys one of these pick-ups it is still a good plan to have built an equalizer designed for a theoretically perfect pick-up, after which a small amount of additional equalization can be applied on account of the actual pick-up. It is then an easy matter to leave out the special pick-up equalization, should one acquire a new pick-up which does not have the theoretically perfect response curve.

Those interested in playing L/P records for the first time are often confused by the variety of equalizer circuits that are presented in the technical press, so in this article, we hope to show readers some simple equalizer networks, and their response curves, that will be found almost universally useful.

BRITISH AND AMERICAN L/P RECORDS

The L/P characteristic given in Fig. (a) is that of the British L/P records, produced so far only by the Decca Company. The main American make of 33 1/3 r.p.m. disk is the American Columbia. This has a characteristic very similar to that of the Deca, but not identical with it. Indeed, so similar are these two characteristics that one wonders why they were not made the same in the first place. It seems rather unlikely that we will be called upon to play American records for some time yet, but this similarity between American and English L/P recording characteristics is of considerable practical interest, because it means that an equalizer designed for American Columbia L/Ps will be perfectly satisfactory for playing our own Decca ones. This is a very worthwhile piece of knowledge to anyone who reads American periodicals.

In order to illustrate this point, Figs. 1 and 2 show two equalizer circuits that have been recommended for use with high-quality magnetic pick-ups on L/P disks. The first was given by Boegli in *Radio News* as being suitable for American Columbia L/Ps, while the second was recommended by West and Kelly, in *Wireless World* for Decca L/Ps. A casual glance at the circuits would lead even the initiated to believe that these two would give noticeably different results, but in practice the difference is so slight as to be imperceptible by ear, and not very pronounced even on a response curve.

the resistors, and that, once these have been chosen, the place at which the boost starts to make itself felt is determined only by the size of the condenser.

Now let us consider the part played by the 0.003 μf. condenser. Everyone knows that a shunt condenser tends to bypass the high frequencies, and this is just what this component is called upon to do. Remembering that the 0.01 μf. condenser can be thought of as short-circuited at high frequencies, the top cut part of the circuit consists of the 33k. resistor. shunted by the 0.003 μf. condenser. This will cause a drop in high frequency response

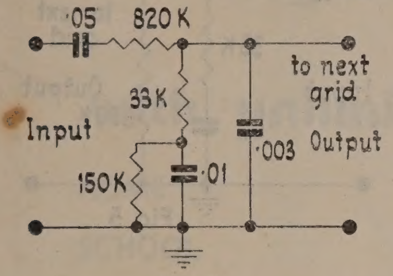


Fig. 1

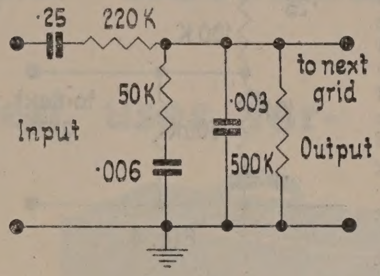


Fig. 2

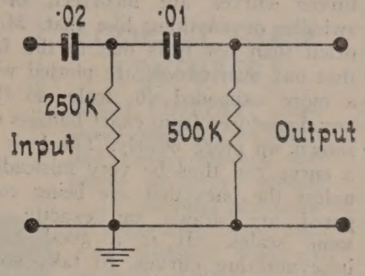


Fig. 3

REQUIREMENT FOR L/P EQUALIZATION

The L/P record characteristic in Fig. (a) shows that these records show an almost straight-line attenuation below 1000 c/sec., and a very similar rise in response above this frequency. Since there is about 30 db. difference in response between the upper and lower extremes of the response curve, it is not practical to use a single CR circuit for compensation over the whole range. The equalizers of Fig. 1 and 2 therefore comprise two CR circuits connected together in a particular way. One portion of the circuit deals with the frequencies below 1000 c/sec., while the other handles the frequencies above this. The condenser at the input end does not enter into the picture, being simply a blocking condenser, put there because the network will most often be placed between two amplifier stages, in which case the D.C. plate voltage of the first must be prevented from reaching the grid of the second. The low-frequency part of the network will be recognized by many as the 820k. resistor, the 33k. resistor, and the 0.01 μf. condenser. This portion has exactly the same form as the simple bass correction network normally used with 78 r.p.m. records. This has been included, for the sake of comparison, in Fig. 4. At high frequencies, the 0.01 μf. condenser has such a small reactance that it can, for all practical purposes, be regarded as a short-circuit. Thus, at high frequencies, in the absence of the 0.003 μf. condenser (which for the moment we are conveniently disregarding) the bass-lift part of the circuit attenuates everything by the same amount. At extremely low frequencies, the reactance of the 0.01 μf. condenser is so high that it can be thought of as an open circuit. In this case, the resistors do not cause any voltage division at all, and the full output from the first stage is passed on, but at intermediate frequencies, the attenuation varies between the two limits mentioned above. The 150k. resistor across the 0.01 μf. condenser is included only to provide a D.C. path to earth from the grid of the valve following the network, and has a relatively small effect on the frequency response. This will be described later.

Those who have used this sort of network with ordinary records will know that the amount of "boost" provided by this kind of circuit is determined solely by

that has reached 3 db. at almost exactly 1600 c/sec., and this drop will continue at the rate of 6 db. per octave up to the highest frequencies. This simplified treatment shows that the net result of the whole circuit must be something resembling the record characteristic, but sloping the opposite way, so that if the curve for the record, and the curve for the equalizer are added together, the result will be a response that is flat from very low to very high frequencies.

Actually, the 150k. resistor plays quite an important part in this circuit since at very low frequencies it limits the amount of bass lift that can be produced. For example, at very low frequencies, the voltage division on the part of the resistors is such that 0.18 of the input voltage is applied to the output terminal. At very high frequencies, the voltage division is such as to give an output of 0.04 times the input voltage. The theoretical maximum bass lift is therefore $0.18/0.04 = 4\frac{1}{2}$ times, or 13 db.

PRACTICAL RESULTS

In Fig. 5 we have drawn the actual response curve of the Boegli network of Fig. 1. This was obtained in our own laboratory by building up the network with standard 20 per cent. tolerance resistors and condensers, and so illustrates the actual performance that can be expected by anyone who may do the same. It will be seen that the final bass lift obtained is 14 db., which is very close to the theoretical figure worked out above. The response falls regularly to about 600 c/sec., where there is a slight kink in the curve. This kink is the place where the top cut part of the circuit takes over from the bass lift portion, and is quite to be expected. The proof of the pudding, however, is to be found in curve B on the same diagram. Here we have plotted the combined effect of the Decca L/P characteristic, and the Fig. 1 network. Nothing has been allowed for the pick-up itself, so that curve B represents the result to be expected if the pick-up is a high-quality one, with an exact constant-velocity characteristic.

The result is a response that is flat within 2 db. from 50 to over 10,000 c/sec., and which falls off in a gradual manner above and below these frequencies. This is a very good answer indeed, leaving nothing to be desired.

Incidentally, the slight falling off at the high frequency end is due mainly to the response of the oscilloscope amplifier which was used to draw these curves.

INTERPRETATION OF CURVES

Most of us, at one time or another, have remarked on the beautifully flat response curves issued by manufacturers, and have found, when it comes to making measurements and drawing curves ourselves, that we do not seem to get nearly such a flat result. This does not mean that manufacturers' curves are incorrect, or a swindle, or anything like that. More often than not it is due to the fact that our own curves are plotted with a more expanded db. scale, so that any departures from exact flatness are shown up more clearly. The look of a curve can thus be very misleading unless the ones that are being compared are drawn on exactly the same scales. It is a good habit, in evaluating curves, to take some reference level, such as 2 db., and see by examination within what limits the curve departs from flatness by no more than this amount. This figure is a good one to take, because in practice, a difference of 2 db. is only just perceptible by anyone with average acuity of hearing, and then only when the signal is a simple tone. Thus, by trying for a 2 db. difference we can be sure that flatness between these limits is for all practical purposes the same thing as absolute flatness. Doing this with curves prevents a deal of misleading conclusions being drawn, as will become apparent when we come to examine the next set of curves.

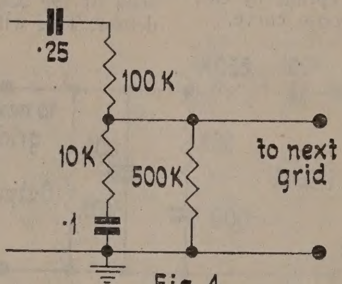


Fig. 4

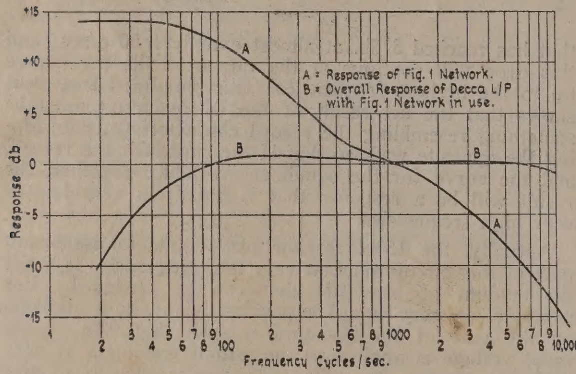


Fig. 6

However, before we leave the equalizer of Boegli, in Fig. 1, we would like to point out that the resulting curve on Fig. 6 (b) was drawn for an English L/P record, whereas Boegli recommends the circuit for use with American Columbia records, whose response curve is NOT identical with that of the Decca. This shows in a practical way how well an equalizer circuit designed for the one type of L/P disk will work when used on the other, and indicates that enthusiasts need have no fear of using an equalizer designed for the American records.

CIRCUIT OF WEST AND KELLY

In Fig. 2 we have the circuit recommended for Decca L/P records by West and Kelly. It differs from the Boegli circuit only in the manner in which a grid return is provided for the following amplifier valve, and in the values used for the components. Here the upper resistor is only 220k., while the lower one is 50k., and at first glance it might seem that it would give an entirely different answer from the first circuit. If it is assumed that there is a 500k. grid leak from the upper end of the 50k. resistor to earth, then the ratio of L.F. response to H.F. response is, according to the circuit values, only four times, or 12 db., which is slightly less than that of the former circuit. However, these simplified calculations do not take into account a secondary bass lift effect given by the top cut condenser in conjunction with the upper resistor in each case. As a result of this, and partly, no doubt, owing to the use of wide tolerance resistors, the West circuit was found to give slightly more bass boost than the Boegli one. The actual response curve of the circuit of Fig. 2 is shown in Fig. 7. It is seen to be remarkably similar to that of Fig. 6, and indeed, when the original curves were plotted, from which these printing blocks were made, it was possible, by superimposing the curves, to show that nowhere throughout the whole range was there a difference of more than 2 db. at any frequency, while at most places, the difference was less than 1 db. Also on Fig. 7, in curve B, is shown the resultant of this equalizer and the record characteristic.

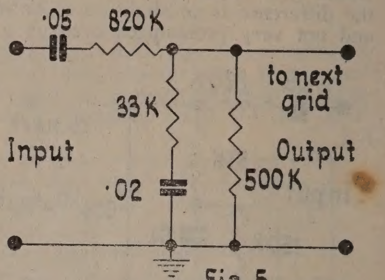


Fig. 5

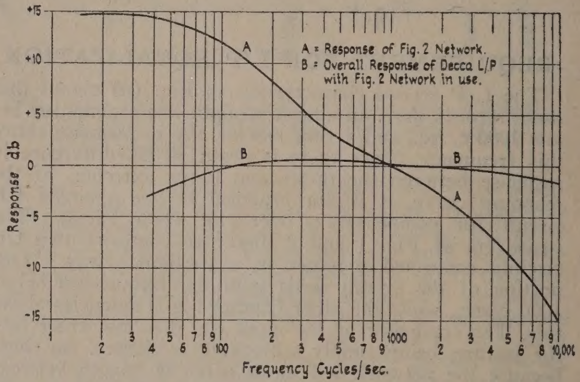
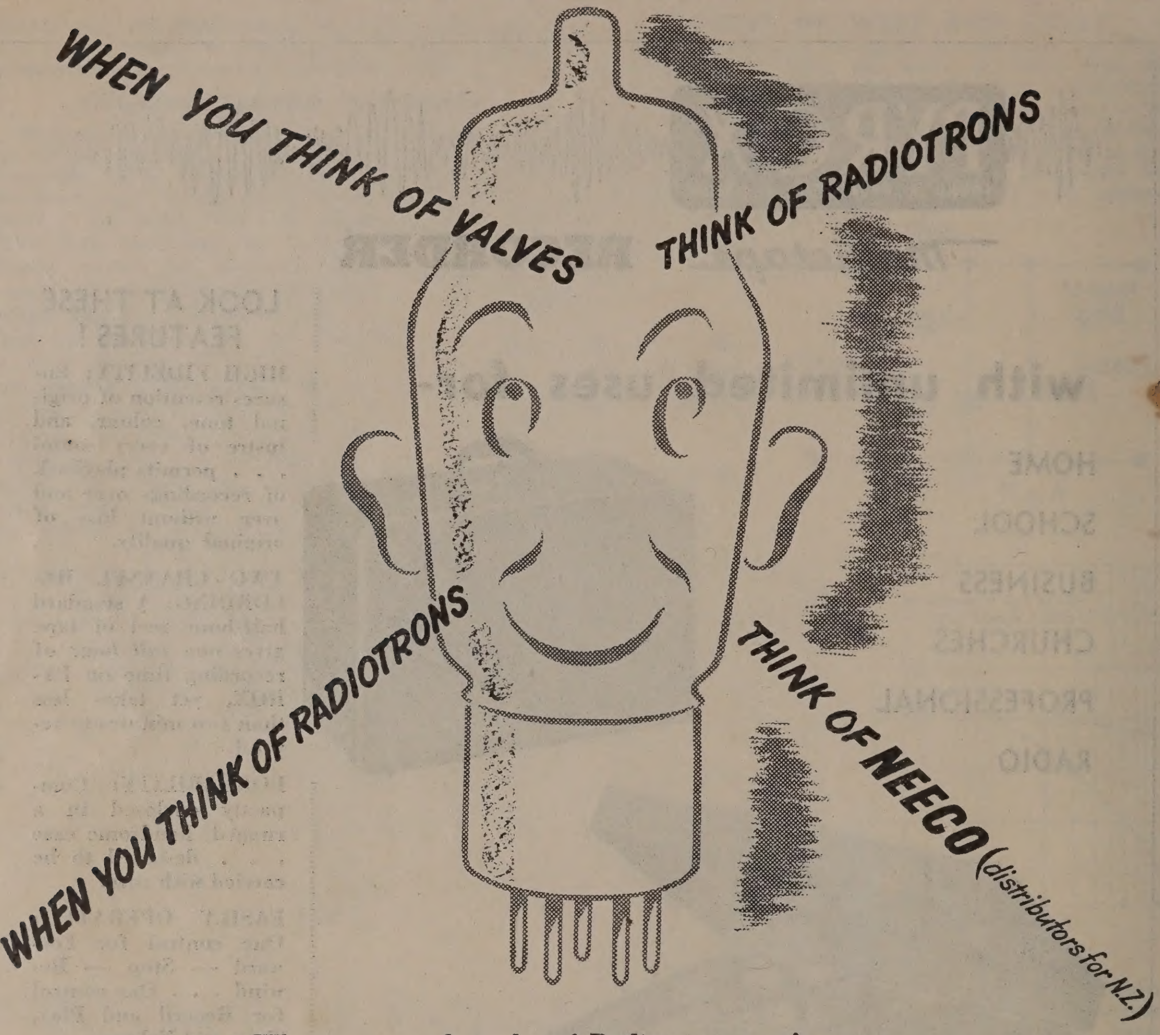


Fig. 7

Now if this is compared with the curve of Fig. 6 (B), the difference appears at first sight to be quite marked, but closer examination shows that the Fig. 7 (B) curve is also flat within 2 db. between 50 and over 10,000 c/sec., so that in practice, results from the two



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would be identical, as far as the ear is concerned, at any rate. And after all, the ear is the final arbiter, from which there is no higher appeal. The conclusion about these two circuits, then, is that other things being equal, it does not matter the proverbial two hoots which one uses, if one has a nice flat pick-up. In fact, if one hoot was made through each equalizer, no one could tell them apart!

WHAT ABOUT NON-FLAT PICK-UPS?

We can surely hear someone saying that he doesn't know whether his pick-up is a proper flat constant-velocity one, or not, so how is he going to get on? Luckily, the answer to this one is not at all difficult. There is only one high-quality pick-up on the market at present whose response differs markedly from the theoretical constant-velocity law. It has a gently rising characteristic at 1000 cycles and above, and can be coped with in two ways. First, if the main amplifier is equipped with a conventional "tone control" which gives a high-frequency roll-off, taking effect at lower and lower frequencies as the control is turned back, then this can simply be set until the results are most pleasing to the listener. It would normally be too much to expect the normal tone control to cope successfully with the quite large amount of high-frequency pre-emphasis possessed by the L/P records, but if this is taken care of by the equalizer, as suggested earlier, it leaves only a relatively small amount of de-emphasis to be provided by the tone control, and this it can quite easily do.

From another point of view there is something to be said for this procedure, because much as the record makers try to make all records as similar as possible from the response point of view, it is always possible for things to happen which will give one record a slight preponderance or lack of highs, so that a small measure of control is an advantage for playing some particular records.

WHEN THE AMPLIFIER HAS NO TONE CONTROL

When the amplifier proper is not provided with a high-frequency tone control, the best scheme is to make the top-cut portion of the equalizer variable in steps. This can easily be done by providing a number of different condensers, in place of the single top-cut condensers, and adding a switch which enables any one of them to be selected at will. For instance, in the West and Kelly circuit, the top-cut condenser is specified as 0.003 μf. If we make this condenser smaller, there will not be quite so much top cut, and the effect will be the same as if we had introduced a small amount of top boost. On the other hand, increasing the size of this condenser will enable extra top-cut to be had, should the record or the pick-up require it. A perfectly practical scheme would be to make this condenser, say, 0.0015, and then arrange a switch so that successive steps brought in further increases of 0.0015 μf. In this way, the condenser actually in use could be varied between 0.0015 and, say, 0.006 in steps of 0.0015. The first step would give slight top boost, the second would give a flat curve, while the others would give slightly increased amounts of top cut, to allow for a pick-up with a rising characteristic, or for records with too much "top."

ANOTHER CONSIDERATION

One of the problems that has to be faced by those using L/P for the first time is that of hum and rumble—particularly the latter. The reason for this is that most of the good pick-ups that are designed for L/P and 78s, have much smaller output voltages to start with than did the not-so-good pick-ups to which we have been accustomed. This means that more amplification is needed for them, and as soon as this is provided, the probability of increased hum becomes apparent. The situation is not eased, either, by the fact that the equalizer circuits used work by allowing the amplifier stages to produce more output at the extreme low frequency end of the scale than anywhere else. This is something over which we have no control, and has to be put up with, and any hum which might appear has to be circumvented by careful design, particularly in the pre-amplifier. The first thing to do is to use a tube or circuit, in the first stage after the pick-up, that is specially de-

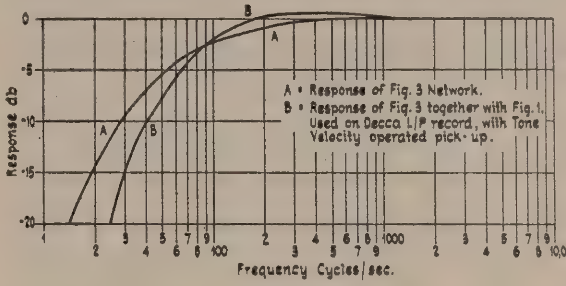

Fig. 8

signed for low hum output. For example, a 6AU6 used in the grounded-plate pre-amplifier circuit, described in *Radio and Electronics* of August, 1950, or an EF37A or EF40 would all make an excellent first stage, with very low inherent hum. Then again, careful shielding of the pick-up leads is esential, and even if these low-hum valves are used, they *must* be positioned as far from disturbing elements such as power transformers, rectifiers, or smoothing chokes as possible.

The above precautions should look after the hum problem successfully enough, but there is a trouble that is much more likely to afflict L/P playing than ordinary 78, and that is turntable rumble. Some turntables produce quite large rumble voltages through actual mechanical vibration of the pick-up at very low frequencies. These frequencies, luckily, are well outside the audio range, being usually between 5 and 30 cycles per second, but if they are allowed to get into a good audio amplifier, they can cause the speaker cone to go in and out in an alarming manner, as well as marring the enjoyment of the music. Luckily, rumble does not affect most magnetic pick-ups very strongly, but some readers will undoubtedly be using crystal pick-ups for their L/P work, since several playing units and automatic changers are equipped with this sort of pick-up. The trouble is that crystal pick-ups are fundamentally much more susceptible to rumble than magnetic ones, and a turntable that is quite satisfactory with even the best magnetic pick-ups, may have too much rumble for good results with a crystal. As buying a new turntable is an expensive, and not necessarily a complete cure, another approach to the problem is desirable. In Fig. 3 is shown a simple and cheap rumble filter, that has been recommended by West and Kelly for use with crystal pick-ups. Of course, it can also be used with magnetic ones should rumble be found troublesome. It is intended to be inserted in front of one of the amplifier stages, and can quite easily be connected after any of the equalizer circuits shown in this article. For example, it could be connected at the output of Fig. 1, without any changes.

If it were connected to the Fig. 2 equalizer, however, it would be advisable to dsconnect the 50k. resistor, since this is no longer needed, the rumble filter already possessing a path to ground for the next grid circuit.

To give some idea of the performance of this filter, two curves have been drawn in Fig. 8. At A is the curve of the filter itself. It can be seen that its response is down 2 db. at 120 c/sec., so that it does introduce a small amount of attenuation within the low-frequency band that we do want. However, this is very slight, and it is doubtful whether its loss down to 50 c/sec. would make a very noticeable difference to the sound of the outfit.

Curve B on Fig. 8 shows the result of adding the rumble filter to the equalizer of Fig. 1. Here, the slight rise of the equalizer below 500 c/sec. is partly compensated by the drop in the rumble filter, so that between 1000 and 100 c/sec., the response of the combination is actually flatter than that of the equalizer alone. But note the performance of the combination at very low frequencies. At 25 c/sec., which is about the highest frequency involved in the rumbling noises, the response is down 20 db., and is dropping at a rate of rather more than 12 db. per octave. Thus, at 12.5 c/sec., it would be at least 32 db. down, and at 6 c/sec., 44 db. The writer once had great difficulty with a loud thump which came from a particular turntable, at a frequency of 7.5 c/sec., and which was due to interference with the natural hum field of the motor, on the part of the strengthening ribs on the underside of the turntable itself. A filter such as Fig. 3 would have effected a complete cure in this case.

COMPARISON BETWEEN 78 AND L/P EQUALIZERS

Since no one will be able to do without their 78 r.p.m. gear just because of the advent of L/P records, and because equalization is different for the two types, most people will be faced with the question of switching equalizers. An exception to this would, of course, be the case where it is decided to use entirely different pick-ups, each with its own equalizer for the two kinds of record. This duplication of gear is not likely to appeal to many, however, particularly since the new L/P pick-up will almost certainly have a second head for 78 recordings. The problem is, therefore, one of choosing an equalizer circuit that can be changed over from 78 to L/P by a simple switching process.

In order to see what is involved, let us look at a very common 78 equalizer circuit. This is given in Fig. 4. We have already noted that the circuit of Fig. 2 is basically similar to that of Fig. 4, if we forget about the top-cut condenser, so that it should be possible to devise a circuit whose resistors remain the same for all types of record, the only changes made being in the condensers. For example, Fig. 5 shows Fig. 1 modified for use on standard 78 records of British origin. Switching this over to Fig. 1 would entail only two single-pole-double-throw switches. One would switch the lower end of the 33k. resistor from the 0.02 μf. condenser to a combination of the 0.01 μf. condenser in parallel with the 150k. resistor. The other would switch the upper end of the 33k. resistor from the 500k. resistor to the 0.003 μf. condenser. That is all there would be in it. Since pick-ups with replaceable heads are always arranged so that their

output voltages are almost identical with 78 and L/P discs, the amplifier stages would not need modification at all.

WHERE TO PUT THE EQUALIZERS

The best place to put any of these circuits is between two amplifier stages. They *can* be put between the pick-up itself and the first amplifier stage, but this is not necessarily the best thing to do. Remember that these modern pick-ups have less output than we have been used to, so that if hum and noise are to be kept to a minimum, it is best to feed the pick-up output straight to the first amplifier stage. Then, when the output has been raised to a respectable voltage level, the equalizer can be inserted in the circuit without much chance of causing trouble. Look at it this way. The circuit of Fig. 2 causes an effective attenuation at high frequencies of almost 15 db., or 5.4 times. Now, if the pick-up has an output, as it well may have, of only 50 millivolts, and the network is inserted straight after the pick-up, the signal voltage delivered to the first amplifier grid at middle and high frequencies is only 9.2 millivolts. Now the network has a fairly high output impedance, so that there is a fair chance of the grid circuit of the valve picking up hum on its own account. If instead, the network is placed after the first amplifier valve, we have two effects: (1) the pick-up, directly connected to the grid of the first valve, has only a low impedance, and the only hum at that point will be that picked up by the input leads; (2) the signal handled by the valve is 5.4 times stronger than it was before, so that any hum arising in the valve itself will be swamped by the signal. Note, however, that wherever the network goes, the overall amplification needed for a given pick-up is still the same!

CRYSTAL PICK-UPS

As was mentioned earlier, crystal pick-up equalization is a different story altogether, and will have to be saved for a later article. In the near future, however, we hope to print details of a universal pre-amplifier for magnetic pick-ups that will answer the questions of those who may feel that the present article does not give them enough detail to start work on such a project on their own.

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WORKSHOP "WRINKLES"

One of the first things that should be considered in any workshop is the proper care of tools, but all too frequently it is a sadly neglected aspect of the day's work.

It is understandable, of course, where pressure of work is so great that one just simply does not seem to get the time to attend to tools, but if the hours wasted by blunt drills, clogged files, etc., were fully assessed, it would soon show that it pays to spend half an hour a week to keep them in good shape.

Drills are one of the most abused of all tools, and many a time the writer has seen some hopeful mechanic "wearing" a hole through a chassis with coils of smoke coming from the drill which is slowly turning a most interesting blue colour! When this stage is reached, of course, the drill might just as well be pitched into the waste metal bin, for it will never hold a sharp edge again. Drills should be sharpened very carefully and with due regard to the work they are supposed to do, but from the average radioman's point of view, a good general purpose cutting edge is all he requires. For the ham-handed, a straight flat on either side of the drill works and is easy to achieve, but by exercising a bit more care a rounded point should be obtained with the cutting edges left high and the trailing edges ground down so that they don't keep the business side of the drill from doing its stuff.

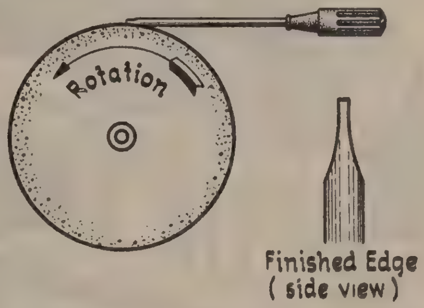
A problem that most people encounter when sharpening very small drills is to get a good shape on them before reaching their thumb nail! The easiest way to sharpen these blown up darning needles is to switch on the bench grinder and then switch off again, using the declining speed of the wheel for sharpening. In the case of a hand grindstone, turn it slowly compared with normal work. Actually, it is rather difficult to sharpen drills on a hand machine, for really one hand is needed to steady the drill while using the other to rotate it. Incidentally, keep oil, fibre, aluminium, brass, and the like metals off your carborundum wheel if you value it. Oil is particularly damaging, for it clogs the wheel completely.

For files the first essential is a file card to keep them clean. It will be found very much easier to clean a file if it is wiped with kerosene before using it, particularly when filing solder for any reason. Solder can clog a file badly, and it is not a bad idea to keep one file for trimming soldering irons only. However, the kerosene "wrinkle" does work. Generally one doesn't realize how bad a file has become until a new one finds its way into the workshop to form a basis for comparison.

Side cutters are very difficult to sharpen, but, given normal usage, very rarely require it. Where necessary, it is best to confine one's activities to honing the blades with a small carborundum slip stone. Sometimes the trouble is caused merely by the blades not closing tightly and a close examination will show that a shoulder or unfinished protuberance is preventing them from closing. This case is then easily remedied.

Screwdrivers come in a variety of shapes and sizes, and from the writer's experience finish up with a variety of queer blades—chipped, burred, seemingly rat-gnawed, and overheated. The last-named is a most common complaint, and renders the screwdriver useless. When sharpening on the power grinder, it is folly to hold them on the wheel until the blade turns blue. The best idea is to dip them in water frequently while sharpening to keep them cool. Also, the most useful edge to give them is a slightly concave or hollow ground one, and this can be done by holding the blade against the periphery of the wheel as shown in the diagram.

A problem that confronts many a person in a radio workshop from time to time is how to attack a large sheet of aluminium without the luxury of a guillotine.



Tin snips are out of the question if anything like a good job is required, for they leave a most unpleasant scalloped edge. All that it is necessary to do is to lay a straight-edge across the sheet in the position where cutting is necessary, and then score the sheet deeply on both sides with a sharp pocket knife. Lay a stout piece of wood across the sheet alongside the scoring, and then bend the sheet up and down until it snaps off along the line. It makes a good clean cut that is all you could wish for. Needless to say, if all the foregoing has been taken to heart, the "sharp" pocket knife for marking the aluminium will be a matter of course!

An Interesting Circuit for an Electronic Timer

Several years ago *Radio and Electronics* published a design for an electronic timer, suitable for use in photographic laboratories and dark room. This circuit had several disadvantages, chief among which was the necessity for a built-in D.C. power supply, which added considerably to the expense. The circuit described here is very much simpler, uses A.C. for all supplies to the tube, and has a better performance, owing to the self-adjusting property of the circuit, which makes it less susceptible to link voltage variations. The circuit is not an original one, having been developed by the General Electric Company, America.

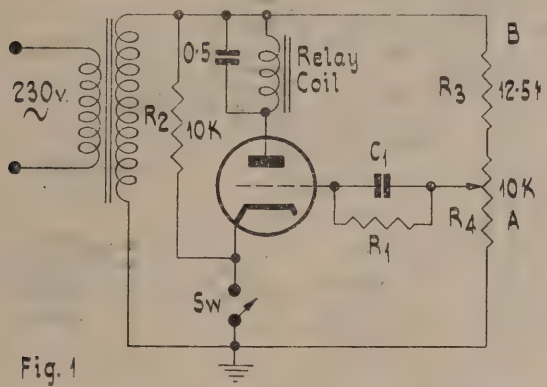


Fig. 1

THE CIRCUIT AND HOW IT WORKS

The circuit is an exceedingly simple one, containing only a handful of resistors, and a potentiometer for controlling the timing function, in addition to a single triode valve, and a single relay. The original circuit was transformerless, but this would not be legal in this country, and into the bargain would be much more likely to be dangerous in use. We have modified the circuit to use a small instrument type of power transformer, which is inexpensive, and which adds greatly to the safety factor, as well as improving the performance. Since the arrangement is entirely A.C.-operated, no rectifier or smoothing filter are required, so that in spite of the transformer, the cost is less than that of a comparable device which needs a D.C. supply for the valve.

The normal condition of the circuit, after a timing operation has taken place, is as drawn in the diagram, with the switch open. In this condition, the plate and cathode of the valve are both connected to the A.C. supply, so that even though these elements are both swinging up and down, positive and negative with respect to the earthed side of the A.C. supply, their voltages are at all times zero with respect to each other. As a result, the effect on the valve is just as if both plate and cathode were connected to the same side of a D.C. supply, and no plate current flows. At the grid, however, conditions are different. The grid is connected to a point on R_4 which is at an A.C. potential with respect to the A.C. line, and thus with respect to the cathode. Because of this, it is possible for grid current to flow during the positive half cycles. Grid current does flow, through the grid leak R_1, and charges up the grid condenser C_1 to the peak value of the A.C. potential between the A.C. supply line and the slider of the potentiometer. When the grid condenser is fully charged in this way, the circuit is ready to have the timing operation started. This is done by closing the switch, Sw, and holding it closed. As soon as this happens, the full transformer voltage is applied to the plate of the valve, through the relay coil, since the cathode is now connected to earth. Now the only D.C. voltage in the whole system is the charge that has been accumulated by the condenser C_1, so that when the switch earths the cathode, this negative voltage holds the valve beyond cut-off, and still there is no plate current. The condenser now begins to discharge through the grid leak, and after the charge has leaked away sufficiently, the valve begins to conduct. When the grid voltage finally reaches such a figure that the plate current has risen high enough to close the relay, the relay closes, breaking the contact circuit, or making it, depending on whether the contacts are normally closed or open.

This is a very simplified version of what happens, because the explanation has not taken into account the fact that even after the switch is closed, there is still an A.C. voltage on the grid of the tube, in addition to the negative D.C. voltage from the charged grid condenser. Nor has anything been said about just how the time delay comes to be what it is, how it is varied to produce different delay times, or what relation, if any, there is between the time delay and the time constant of the grid circuit.

DETAILED GRID CIRCUIT ACTION

In the first place, it is important to note that R_3 is a little larger than R_4. If we label the A.C. line B, the potentiometer slider as A, and the earth line as C, then we have the following. When the switch is open, the voltage AB is developed between grid and cathode of the valve. (The relay coil has no effect because it is not in the grid-cathode circuit, and R_2 can be neglected because it is so very small compared with R_1.) Suppose, for the sake of illustration, that AB is 100 volts R.M.S. and AC is 50 volts R.M.S. In this case, the condenser C_1 will charge up to almost exactly 1.41 x 100 volts D.C., or —141 volts. The minus sign simply indicates that the grid is negative with respect to the other end of the grid leak. Now let us suppose that we can arrest the action of the circuit at the moment when the switch is closed. At this moment, then, there will be a steady potential of —141 volts on the grid, with respect to the cathode. In case some may have difficulty in seeing this is so, it should be pointed out that the polarity of the charge on the condenser is as marked, and that the slider of the potentiometer is at zero D.C. potential with respect to the cathode, since there is only alternating voltage at this point. If now we let the action go on for, say, a fiftieth of a second, we find that in this short period the condenser has hardly had time to lose any of its charge, but we remember that there is an A.C. potential of 50 volts R.M.S. being applied to the grid. Because of this, the grid is taken positive and negative about its average potential, which is the D.C. voltage of —141 that we have been talking about. The peak value of the A.C. voltage at the grid is 1.41 x 50, or 70.7 volts, so that at the positive peak of the A.C. cycle, the actual grid voltage is $-141 + 70.7 = -70.3$. At the negative peak of the cycle the grid voltage is $-141 - 70.7 = -211.7$. Thus, the actual grid voltage is following a variation something like the solid line of Fig. 1. However, this does not have a particularly great effect on the timing when the voltage AB is much greater than the voltage AC. It does explain, however,

why R_3 is a little larger than R_4. For at high settings of the potentiometer, the voltage AB becomes smaller, and so therefore does the D.C. potential to which the grid charges. At the same time, the voltage AC gets larger. Now if AB were able to be larger than AC, there would be no time delay at all, except for the indeterminate time taken for the positive peak of the first A.C. cycle after the closing of the switch to bring the grid above cut-off. This time *would* be indeterminate, moreover, because it would depend on the point on the A.C. cycle that was chosen for closing the switch, and there is no control over that. Fig. 2 shows three settings of R_4. At (a) we have the grid voltage variation after the closing of the switch, when the slider of R_4 is right at the earth line. In this case there is no super-imposed A.C. at all, for obvious reasons. At (b) we have illustrated the situation when the slider is a small distance up from the earthed end, while at (c) we have the position when the slider is at the top of its travel. In the latter case, it can be seen that the A.C. is not quite equal to the charge on the condenser, so that the first positive half cycle almost brings the grid into the conducting region of the plate characteristic of the valve.

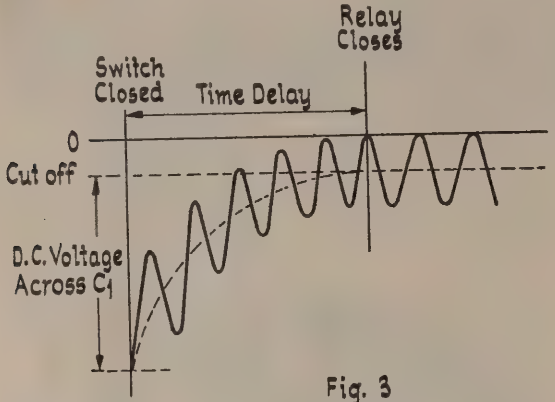


Fig. 3

TIMING CONTROLLED BY R_4

The illustrations in Fig. 2 show how R_4 controls the timing function, in spite of the fact that the long time-constant in the grid circuit remains unchanged. When the condenser charging voltage, AB, is high, and the A.C. grid voltage AC is small, the condenser has to discharge to a much greater extent, before the tube's grid voltage comes within the conducting region, while the reverse is true when the condenser voltage is small, and the A.C. grid voltage large.

SELF-COMPENSATION

One advantage of this circuit compared with other, and often more complex ones, is that there is a certain self-compensating action that takes place, should the A.C. line voltage vary. This arises because both the condenser charging voltage, and the A.C. grid voltage are directly derived from the A.C. line, and act so as to cause opposing effects. For example, if the line voltage rises, the condenser voltage increases, tending to lengthen the time interval between the closing of the switch and the pulling in of the relay. But when this happens, the A.C. grid voltage is greater, too, and this tends to decrease the timed interval. This compensation is greatest for the shorter time intervals, and it is probable that at one particular setting of R_4 the compensation is exact. There can clearly be no compensating effect at the longest time interval obtainable, because here there is no A.C. grid voltage at all. The net result is that the shorter intervals are more accurately timed, under conditions of changing line voltage, than are the longer ones.

There is another effect, too, which increases the timing accuracy for the short intervals. It is that for these intervals, the grid voltage curve is crossing the cut-off line for the valve at a much steeper angle than it does during the long intervals, so that the point at which the relay pulls in is more clearly defined with short times than with long ones.

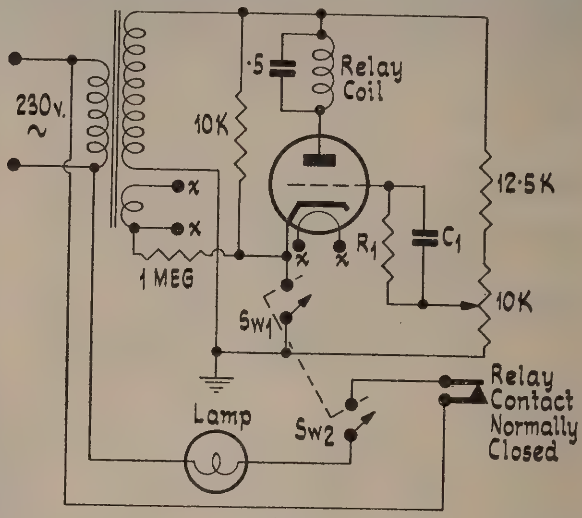


Fig. 2

However, all this does not indicate that the longer intervals are not timed accurately enough, and the constancy of the intervals, for repeated operations at a particular setting of R_4 will be found to be very good.

RELAY CHATTER

Although the current can flow in the plate circuit of the valve only in one direction, this current is not steady, but consists of a series of pulsations, each one having the shape of half a sine-wave. Indeed, the plate current in the relay circuit, if examined on an oscilloscope, would look just like the plate current of a half-wave rectifier. On account of this, an ordinary D.C. relay will have a decided tendency to chatter, unless it has what is known as a shading ring. This is a single short-circuited turn of heavy copper wire or strip, fitting tightly round the armature end of the core, and is to be found on all relays that are intended to work on alternating current. However, the relay to be used with this circuit will need to be a fairly sensitive one, if a small tube like the 6J5 is used. It should pull in on, say, 1.5 ma. D.C., and any relay that will do this will have a coil of many turns of fine wire. As a result its inductance will be high, and it will be possible to keep it from chattering by paralleling the coil with a fairly large condenser. On the circuit diagram we have shown one of 0.5 μf., and with a relay coil of several thousands of ohms resistance, this will effectively keep the relay in without chattering, by discharging into the relay coil during the negative half-cycles, when the valve is not passing any plate current.

USE OF OTHER VALVES

There is no compulsion about using such a small valve as a 6J5. If a slightly larger valve is used, such as a

6V6 connected as a triode, the plate current will be greater, so that such a sensitive relay will not be required. At the same time, the timed intervals will be a little shorter, but not so much so as to make any worthwhile practical difference.

INTERVALS OBTAINABLE

Perhaps of greatest interest to the builder of a circuit like this, apart from the fact that it works, is the range of times that can be obtained. It is a simple matter, of course, to build in more than one timing range, by switching either C_1 or R_1, but it is necessary to know the variation that can be obtained by means of R_4 for fixed values of time-constant in the grid circuit.

In practice, it is found that the longest time obtainable

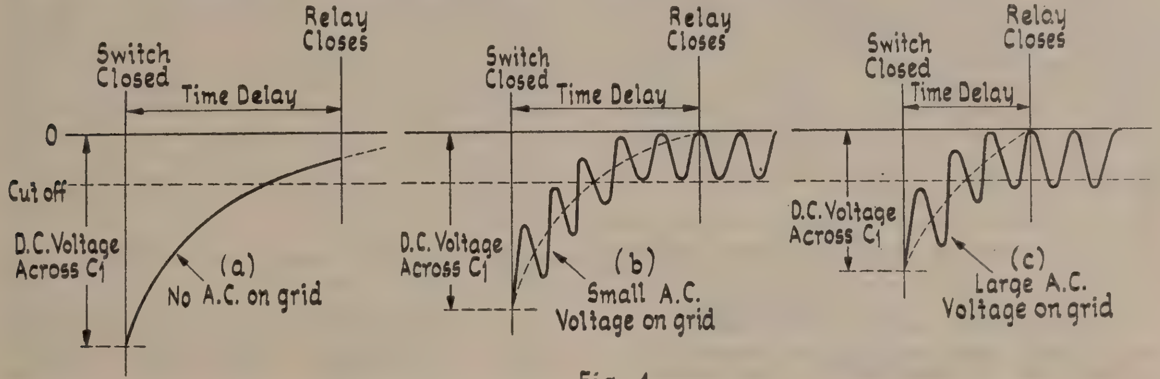


Fig. 4

is very nearly four times the time-constant of the combination C_1R_1. For example, should R_1 be 10 megs., and C_1, 1 μf., the time-constant would be 10 x 1 = 10 secs., and the greatest time interval obtainable would be about 40 seconds.

SCALE SHAPE

Having built the circuit, and arranged the grid circuit values so that we get a delay of however many seconds we want for our greatest time interval, the next point of interest is what sort of scale we will get if we calibrate R_4 so that its pointer indicates the intervals obtainable at various settings. For instance, do we get a linear scale, with the time divisions equally spaced, or will the scale be cramped at one end? The answer is that the scale is spread out at the shorter times, and more crowded together at the longer times *if we have used a linear potentiometer for R_4*. At first sight, this might seem to be a disadvantage, but this is not really so. Actually, the scale follows a logarithmic law, with the very suitable result that the accuracy with which the potentiometer can be set is the same at all parts of the scale. That is to say, whether the interval being used is at the short or the long time end of the scale, the accuracy of the interval actually obtained will not depend on the position at which the pointer has to be set. The longer intervals do not become unduly cramped, owing to the choice of R_3 and R_4, while at the other end, the calibration spreads out nicely, and enables an interval of one-twentieth of the full-scale reading to be easily set. Thus, if the potentiometer is scaled for, say, 40 seconds as the maximum interval, the smallest interval that can be read will be about 2 seconds. This would make a very suitable range for , say, a photographic enlarging timer, in a case where it was not desired to complicate matters by having more than one range. On the other hand, should more accurate short-time settings be needed, it would not be difficult to switch in a different resistor or condenser to give a maximum time of, say, 10 seconds. This would give marked intervals from 0.5 seconds to 40 seconds, for the two ranges, and it would be quite possible to arrange matters so that only the one scale was used, the long range readings being obtained by a multiplying factor of four, from the direct calibration for the short range.

CHOICE OF RESISTOR AND CONDENSER

In organizing the greatest time interval to be obtained, it is possible to choose an infinite number of combinations of C_1 and R_1. This is because as long as the product megohms x microfarads is, say, 10, the time-constant is always 10 seconds, whether we have used 10

megs. and 1 μf., 1 meg. and 10 μf., or any other combination. The question is, what governs the choice of a small condenser or a large one, as long as the resistor is chosen to suit?

This is where purely practical considerations have their say. In the first place, we require as good a condenser as possible, with the smallest possible leakage resistance, for if this resistance is not much higher than the resistor which theory says will be needed, then the time intervals we get in practice will be much shorter than the calculated time. For time reason, it is a good plan to make the condenser as small as possible, because the smaller the condenser, the smaller its leakage will be, for a given quality of construction.

On the other hand, unless high-stability cracked-carbon resistors are used for very high values like 10 megs., the stability of the resistor is not likely to be very good. For example, ordinary 10 meg. resistors vary considerably from even their official 20 per cent. tolerance, and in addition, suffer from changes in value with changes in temperature and humidity. It is thus a good plan, too, to make the resistor as small as possible! This indicates that moderate values for both components will be better than a very high value of either.

In case this should put some intending constructors off, it should be pointed out that unless one is building a number of such timers, each of which has to conform to a standard calibration, made in advance, these considerations are not nearly as troublesome as they might be. For practically all purposes, for which the timer might be wanted, great accuracy is not essential. Taking the photographic case once more, it is well known that except for very special processes, such as the timing of exposures for colour separation negatives or prints, the accuracy required is not at all high. Variations of plus or minus fifteen per cent. in the exposure time for a black-and-white enlargement would just not be visible on the finished print, so that any trouble or expense taken in an attempt to greatly increase the accuracy over what can be obtained with more or less standard components, will be largely wasted. If one timer only is being made up, it will have to be individually calibrated anyway, so that there is no point at all in trying to get specific values of condenser and resistor for the grid circuit. For instance, if it is decided to go for a maximum time of 60 seconds, a reasonable compromise on the values of C_1 and R_1 would be 4.0 megs. and 4 μf. Incidentally, the voltage rating of the condenser does not need to be higher than 250 volts, and this will allow a somewhat smaller condenser to be used. We would thus use two 2.0 meg. resistors in series for R_1, and two 2.0 μf. 250-volt condensers in parallel for C_1. Suppose, then, that after these have been inserted in the circuit, the maximum time is found to be just short of 60 seconds. There are three possibilities. First, that the resistors do not total up to the right value; secondly, that the condensers do the same; and thirdly, that the condensers, or one of them, are leaky. The first thing to do is to test the condensers for leakage. If they are charged up to, say, 250 volts from a D.C. supply, and it is found that they hold their charge for several minutes then all is well, and they can be used. It is possible, of course, that the short timing might then be due to both the condensers and the resistors being too small, so that things can now be rectified by adding a further resistor in series, just large

enough to bring the timing up to what is wanted, or else by adding more capacity in parallel. For an adjustment of this nature, it is best to use more resistance, since adding another condenser, however small, increases the chances of encountering condenser leakage, either now or at some time in the future, while adding resistance has no such undesirable possibility.

When the maximum time has been arranged in this way, it is possible to proceed with the calibration, which can quite readily be done with an ordinary stop-watch.

CALIBRATION

Let us assume that the circuit has been built up, and the maximum time has been achieved by the process described in the last paragraph. The next thing is to fit a piece of card firmly behind the pointer attached to R_4. Once this paper has been placed in position, it must on no account be moved, because should this happen, the calibration will have to be started all over again. The circuit is given time to warm up, and, with the pointer set near the end of the scale, the stop-watch is started, and the switch is depressed simultaneously. When the relay is heard to click in, the watch is stopped, and the time read off. There are two ways now in which we can proceed. The first is to make a slight movement of the pointer in the direction required to bring the time to the maximum that is to be marked on the scale. Then, the time and the watch are again started at the same time, and another reading is taken. When several trials, at the same position, average out to the required time, the pointer position is carefully marked, and the time written alongside the mark. If this procedure is repeated for all the marks needed, then the paper will end up by being a properly, if roughly drawn scale, which can be taken off, duplicated in a more presentable form, and re-attached. To do this last, the best way is to set the pointer in as nearly the correct position as possible, and then to take a test time to see whether 60 seconds comes at 60 seconds on the scale. If it does, all other calibration points will be correct.

The second method involves drawing a graph, but will probably give just as accurate an answer, in a good deal less time. It is carried out as follows: First of all the paper scale is attached to the instrument and the pointer is screwed on. Next, a sharp pencil is carefully held against the tip of the pointer, which is then turned right round, scribing an exact circle on the paper. Then, starting at one end, the time is measured, and written in, for a large number of points all round the blank scale. These points are numbered as we go along, and a list

of the numbers is kept at the the same time, showing the time that was obtained at each one. In this method, it does not matter in the least if the times obtained are all odd ones, such as 21 3/5 secs., or 21.6 as it would be better to write it. In this way, a lot of time is saved, because there is no constant set-and-try in order to fit the times to particular values.

When the scale has been covered in this way, with as large a number of readings as convenient, the paper scale is removed from the instrument, and is then firmly fixed with cellophane tape to a clean sheet of paper. The next step is to find the centre of the circle made with the pointer and pencil, in the first step. This can be done by the well known construction of drawing two chords, and drawing their perpendicular bisectors. Where the bisectors cross is the centre of the circle. The underneath sheet of paper is needed because the centre of the scale has had to be cut out to accommodate the pointer shaft. Having found the centre of the circle, a line is drawn from it to one end of the scale—i.e., the first or last mark, representing one end of the pointer's travel. A piece of graph paper is now prepared with suitable divisions for time along one axis, and divisions for degrees along the other. Now, using a protractor to measure the angles at which the various points on the scale come, the graph is drawn of time versus angle by plotting a point for each measurement that was made. When all points have been plotted, they are connected up by a smooth curve, running as evenly as possible among the spread of the experimental points. If all has been carefully done, it will be found that particularly at the long-time end, the points lie very nicely on the smooth curve.

The last step is to draw the final scale. This is laid out as a circle the same diameter as the original one, with one radius marked in as the starting point for measuring the angles. Then, by reading off the angle shown by the graph for the exact times we wish to mark on the scale, these angles can be applied to the new scale with the protractor, and the calibration points put in for 2, 3, 4, etc., seconds up to the maximum time. It will be found that the scale is such that up to ten seconds, the individual seconds will be marked in with quite wide spacing, so that it will be easy to include all of them. After this, it will probably be better to forget the individual seconds, and mark only 5-second steps. And at the extreme high end, only the 10-second steps will be put in. All this is quite in accordance with what we said above regarding the accuracy with which the scale can be set.

Although the second method takes a long time to describe, it is much the best to use, and is probably much quicker and more accurate than the other method.

CHOOSING A RELAY

If a 6J5 is used, the relay needs to operate positively at a direct current of just over 1 ma., which is rather on the sensitive side. With a triode-connected 6V6, however, a relay pulling in at between 4 and 5 ma. will be found satisfactory. The best type of relay to use is a telephone type relay, because these are extremely reliable, and

will not give trouble through getting out of adjustment. A relay that is excellent for both types of tube, if it can be obtained, is the sensitive relay from an SCR522 receiver. These have a D.C. resistance of 5000 ohms, and can be adjusted to pull in at very small currents with great reliability. The recommended arrangement would be one of these relays, or a telephone type relay with a coil of 3000 to 5000 ohms resistance, in conjunction with a triode-connected 6V6. In either case, the contacts should be able to handle the current of a 100-watt lamp without sparking and burning up. Since the operation of the timer *closes* the relay after the time delay has elapsed, the contacts must be made when the relay is de-energized, breaking the circuit when the relay pulls in. The method of operation would be to leave the switch in the open position. This enables the condenser to charge up, and when the switch is closed, the lamp comes on, both the relay contacts and the lamp section of the switch being closed. When the interval expires, the relay contacts open, shutting off the lamp. Now, when the switch is returned to the open position, the relay drops out, closing its contacts once more, but the lamp does not light because the switch is open.

If the circuit is to be used as a time delay, for turning on one circuit, after a different one has been turned on, as when it is necessary for an H.T. supply to come on only after a fixed delay time, the switch on the timer can be ganged with the switch that operates the first function. Then, after the time delay, the relay closes, and turns on the H.T. supply. In this case, the relay contacts would need to be normally open, closing when the relay is energized.

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The "RADIO and ELECTRONICS" Abstract Service

AERIALS AND TRANSMISSION LINES

Aerials for "in a hole" operating. The article describes construction of a very long feeder for leading out to the top of a hill-top and terminating in two fixed aerials at right angles to each other for two bands. A non-resonant 600-ohm line is used with relay switching.

—*QST* (U.S.A.), November, 1951, p. 39.

Folded dipoles are frequently used to obtain an impedance transformation in antennae systems. More accurate formulae have been determined for the impedance transformation that takes place and convenient charts are given for the estimates.

—*Ibid*, October 1951, p. 52.

The measurement of current distributions along coupled antennas and folded dipoles. The paper presents experimental results verifying the physical concept of current on closely coupled antennas and folded dipoles.

—*Proceedings of the I.R.E.* (U.S.A.), December, 1951, p. 1561.

A switch is discussed designed to permit rapid scanning of *a* sector by means of a multiple-dish rotary antenna. As a rotor spins with the antennae assembly, power is successively delivered to each feed while the others are short-circuited.

—*Ibid*, p. 1566.

CIRCUITS AND CIRCUIT ELEMENTS

Five power supplies are described which are particularly interesting because of the high degree to which some of them are regulated and the unusually high current ratings. The system is of grid controlled thyratron rectifiers in a pre-regulator which work with servo stabilized D.C. amplifiers to provide a very high degree of regulation.

—*Electronics* (U.S.A.), December, 1951, p. 109.

High level filtering for transmitters came into use for preventing the radiation of spurious high-frequency sidebands, but there is an inherent defect in a series-diode type of high level clipper-filter system, A better approach to high level clipping and filtering is described.

—*QST* (U.S.A.), November, 1951, p. 18.

The idea of using more than one crystal to give a narrow bandpass filter is not new but it has not been exploited to the fullest extent. The article shows a few lattice types with typical response curves for the various circuits.

—*Ibid*, October, 1951, p. 56.

Recoupling network for pulse transmission and criteria for maximum pulse sharpness. A resistance-capacity differentiator is analysed when acting in conjunction with a normal form of intervalve-coupling network and the analysis leads to expressions defining the conditions for maximum pulse sharpness.

—*Wireless Engineer* (Eng.), November, 1951, p. 345.

ELECTRONIC DEVICES

The international standard of concert pitch is based on a frequency of 440 c/sec. for the note A3, and more accurate standards are being developed. This has necessitated the manufacture of better tuning forks, and a method is described of doing this work.

—*Philips Technical Review*, Vol. 12, No. 8, p. 228.

MATERIALS, VALVES, AND SUBSIDIARY TECHNIQUES

A search for methods of supplanting radio tubes has led to the investigation of the dielectric amplifier. The amplifier depends on the control by a low power source of the A.C. reactance of a capacitor. These changes in reactance are in turn used to produce changes in the current flowing in an A.C. power circuit. The dielectrics used with the most promise are barium titanate and certain combinations of strontium, etc. The devices are at about the same stage as vacuum tubes were prior to World War I.

—*Electronics* (U.S.A.), December, 1951, p. 84.

Transistor circuit design. Many will be interested in practical circuits for the transistors. The article shows how to derive amplifier, oscillator, modulator, and multi-vibrator transistor circuits from known vacuum-tube circuits. The technique, known as duality, is explained in detail and may be applied to any complex vacuum-tube circuit to find the corresponding transistor circuit.

—*Ibid*, p. 128.

MEASURING INSTRUMENTS AND TEST GEAR

A frequency spotter for the novice. Even though the transmitter may be crystal controlled, a wavemeter of some kind is still necessary. The instrument is an easily calibrated 50 kc/sec. marker oscillator for 80 metres with a Colpitts oscillator plus a harmonic amplifier. Used in conjunction with a receiver it will insure that the transmitter is accurate.

—*QST* (U.S.A.), October 1951, p. 30.

Photometric instruments suffer either from instability and drift or from objectional complexity and cost. Two lamps in out of phase oscillation indicate bridge unbalance and serve as two light sources for comparison measurements.

—*Electronics* (U.S.A.), December, 1951, p. 93.

An automatic impedance matcher. Such devices are desirable in matching the input impedance of a given antenna to the characteristic impedance of a given feeder line. The one described can also be adapted to different frequency range, power level, type of load and transmission line for other communications and industrial applications.

—*Ibid*, p. 98.

A wide band converter for a signal generator. Frequency modulated and amplitude modulated signals are provided over the whole range of frequencies from 100 kc/sec. to 216 mc/sec. by a generator operated in conjunction with a wide-band converter.

—*Ibid*, p. 118.

Measuring the de-ionization time of gas-filled diodes and triodes. Attention is devoted to the influence that ions have on the properties of the tubes. After the current ceases to flow it takes the tube a certain time to become free of ions again and this sets a limit to the permissible frequency.

—*Philips Technical Review*, Vol 12, No. 6. p, 178.

After a valve oscillator has been turned on its frequency tends to drift because various sources of heat are brought into play. With the frequency drift meter described the problem has been solved by generating a series of harmonics from a test crystal oscillator to monitor the oscillator adequately

—*Ibid*, Vol. 12, No. 7, p. 193.

MATHEMATICS

The question of transient responses is one of the most difficult problems in radio. In this article the necessary and sufficient conditions for transient responses when a network is stimulated are considered with reference to the location of zeros of the impedance function which is as important as the poles. Conditions for monotonic responds are derived for certain networks.

—*Wireless Engineer* (Eng.), November, 1951, p. 330.

PROPAGATION

Ionospheric cross-modulation. The Luxembourg Effect was reported in 1924 and has been the subject of a great amount of study. The article refers to the theory and some experimenting done in this subject and the practical aspect of overcoming the defects.

—*Wireless Engineer* (Eng.), November, 1951, p. 335.

RECEIVERS

Receivers for use at 460 mc/sec.—general design considerations, performance of valves and circuits, and the careful control of thermal noise.

—*Ibid*, p. 323.

A V.H.F. receiver for the novice or technician in the 144 to 220 mc/sec. range. This is of simple design with a coaxial line tank circuit and super-regenerative detector. The set should be a very interesting one to construct.

—*QST* (U.S.A.), November, 1951, p. 33.

TRANSMITTERS AND TRANSMITTING

A good mobile transmitter for 14 and 28 mc/sec. having a 30-watt rig and solenoid type switching circuits. The set permits the operator to change frequency in double quick time. Full details of construction are given.

—*QST* (U.S.A.), November 1951, p. 11.

Most Air Force boys will be familiar with the "Command" transmitters used on American planes. The set certainly requires a good deal of modification especially in regard to the power supply, but a cheap and reliable instrument should result.

—*Ibid*, p. 23.

Modulating the screen grid of a beam tetrode is a useful method of radio-telephony, but it is different from modulating the grid of any other tube. The article deals with linearity with screen modulation, combined screen and control grid modulation coupling the modulator to the screen and waveform shaping.

—*Ibid*, p. 43.

How to keep a single sideband a single sideband. An explanation in simple language of the difficulties with this kind of transmission and of the factors that contribute to distortion in linear amplifiers. A very useful article.

—*QST* (U.S.A.), October, 1951, p. 22.

The PHILIPS Experimenter

An advertisement of Philips Electrical Industries of N.Z.,Ltd.

No. 53: Adding a Power Amplifier Stage to the S.S.S.C. Exciter

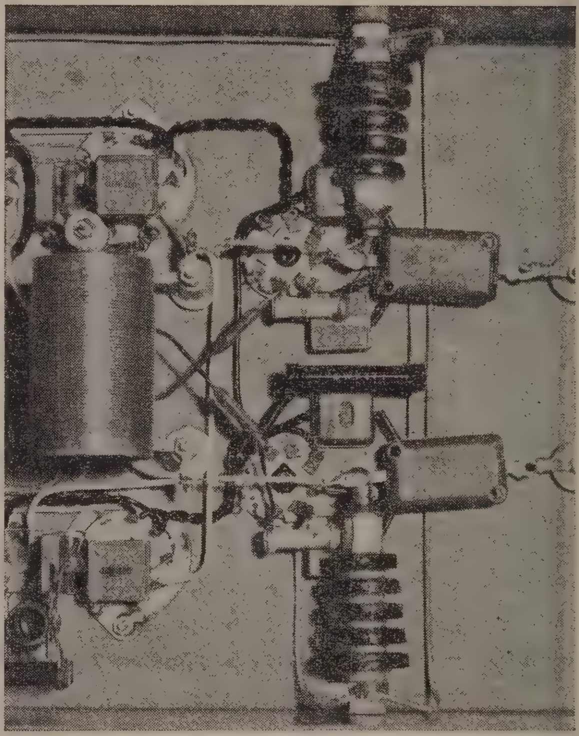
As was mentioned at the beginning of the Philips Experimenter series of articles on the S.S.S.C. generator, the output of this device was designed to be of very low power only. This was done with the purpose of simplifying the exciter unit itself, and, incidentally, of keeping down its cost, because it is a very simple and inexpensive matter to get a considerable output power in a very few stages, once the single sideband has been generated. Accordingly, provision was made on the chassis for adding a power amplifier which would bring the output up to several watts—enough for a low-powered transmitter, and for exciting almost any high-powered stage that might be sought after. The present Experimenter describes the construction, setting up, and performance of a Class A amplifier which can easily be made to give up to 20 watts of sideband power. This, readers will remember, is equivalent to a normal A.M. transmitter of 80-watt *carrier* power, which rather emphasizes the value of the S.S.S.C. technique in saving money on transmitter construction!

PHILIPS EL37s USED

In order that the power output should be great enough to use as a transmitter on its own, Philips EL37s were chosen for the power amplifier stage to be described. A glance at the Philips valve handbook shows that for push-pull Class A audio application, the EL37 can be operated under the following conditions.

From these figures, one can work out that for a total power input of 43 watts, an efficiency of 41.5 per cent. is obtained. This is very high for a Class A stage, regardless of frequency, and it is hardly to be expected that if we use the same valves under similar conditions, except that the frequency is in the region of 3.5 mc/sec., we will obtain as much output as this, but even if the losses were considerable, the output would be more than a useful figure. Even at an output of, say, 12 watts on modulation peaks, the output would be equivalent, as far as a receiver is concerned to that from a 50-watt A.M. carrier.

Perhaps some readers are wondering why we are bothering about Class A power amplifiers, and not Class C ones. The reason is that we are now dealing with a modulated signal, which must be handled by a linear amplifier if the signal is not to be greatly distorted. This immediately rules out the Class C amplifier altogether, and we are faced with working our power amplifiers either Class A or Class B. And while there is not a great deal of difficulty about setting up a Class B linear stage for S.S.S.C. working, a Class A stage is much easier, and still has a useful output. Now because the valves are to work in Class A, all we need to do to get them going is to operate them under exactly the same conditions as if they were an audio amplifier. Thus, the plate and screen voltages, the grid bias, and the grid input voltage are exactly the same as for Class A audio. Tuned circuits, as for any R.F. amplifier, are substituted for plate and input transformers, or, as here, resistance-capacity coupling can be used in the grid circuit. Owing to the frequency, however, neutralization will be needed,



Showing the symmetrical layout of the EL337 stage. The feed-through insulators on the right lead through to the EL37 plate tank coil.

because the Philips EL37 was designed with a fairly large grid-plate capacity of 1 $\mu\mu$f. This is great enough to make neutralization essential, but no difficulty at all was experienced here, and we do not think that builders will have trouble either.

THE CIRCUIT

The circuit is quite straightforward, but one or two features could do with some comment. First of all, there is the tapping of the EL37 grids down the exciter tank coil. The taps are exactly half-way between the ends and the centre. In actual practice, the leads are crossed over as in the diagram. This was done to enable the neutralizing condensers to be taken straight from the ends of the exciter tank coil to the plate pins on the EL37 sockets. The idea of this is simply one of preserving symmetry in the circuit layout. A glance at the photograph will show that it would be difficult to make the physical layout more balanced, and the trouble taken in this respect

has more than paid dividends by making the neutralization process easy. An additional advantage is that taking the neutralizing condensers to the ends of the exciter tank rather than directly to the grids, increases the capacity required for neutralization, thus making adjustment less critical. The cathodes of the valves are bypassed for R.F. only, because, as with all Class A stages, the D.C. plate current is almost constant. The screens have been bypassed separately in order to preserve symmetry, and as a precaution against parasitics.

Parallel feed has been used in the plate circuit, so as to remove H.T. voltage from the output tank coil and condenser, which are mounted above the chassis. The plate tank capacity is quite large, for reasons that will be discussed later, and this necessitates the use of fixed condensers from each end of the tank to ground. The 150 $\mu\mu$f.-per-section variable gives plenty of adjustment range for the 80-metre band, and will be large enough by itself if the unit is later modified for any of the higher bands. A fixed link has been provided, for feeding into an aerial tuner, where the coupling can be varied to make the loading correct for the amplifier. If desired, the variable link could be placed at the transmitter end, with a fixed link at the aerial tuner. Which system is used is merely a matter of personal preference.

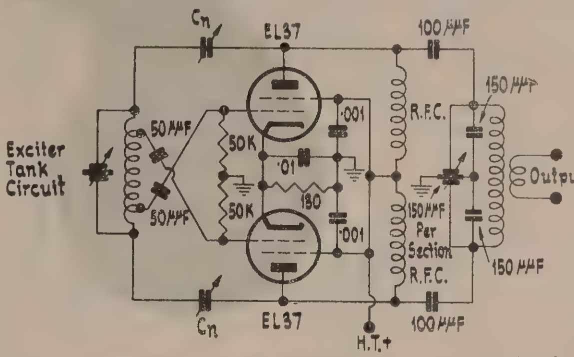
ADJUSTMENTS REQUIRED

There are only three adjustments to be made when the amplifier is completed, assuming, that is, that the exciter is functioning properly. They are neutralization, excitation, and loading of the plate circuit. The first of these is straightforward, except for the fact that the grid-current method of neutralizing cannot be used, but the other two cannot be done by any of the methods used with the familiar Class C amplifier. For example, the grid circuit, which is also the plate circuit of the exciter, cannot be tuned for resonance by observing grid current, because there is none. Similarly, the plate tank cannot be resonated by watching the plate current dip, because there isn't one of those, either! However, things are not quite as bad as they might seem, especially if a simple absorption wavemeter is available, or if a 'scope is to be used, which is the most desirable method.

NEUTRALIZATION

First of all, the EL37s are plugged into their sockets, but with plate and screen voltages removed. The exciter is turned on, together with its R.F. excitation, and the wavemeter is held near the exciter plate coil. If the modulators are particularly well balanced, there may not even be enough output on which to tune the wavemeter, but in this case, it can be tuned by bringing it near the oscillator or buffer which feeds the exciter unit. With the wavemeter on frequency, it will probably be possible to obtain a reading by bringing it near to the modulators' tank coil, but here again, the balance might be so good that a large enough reading cannot be obtained without quite tight coupling. In this event, one of the balanced modulators should be slightly unbalanced, so that a little carrier is present, or else the audio oscillator can be fed into the microphone input terminal, and the gain control turned up a little, providing some R.F. in the tank circuit of the modulators.

The modulator plate circuit is then tuned as accurately as possible. The R.F. input is then removed, by turning off the source, and the audio input is also turned off, if it is being used. The plate and screen supply to the EL37s is then turned on. Since the stage is biased for Class A operation, there will be a plate current *of* approximately 120 ma., together with a screen current of 15 ma., making a total of 135 ma. This figure, or something like it, will be obtained if the output stage is not oscillating, but if it is, the total current may be considerably less, depending on how strong the oscillation is. Now, without moving the modulators' plate tank circuit, the amplifier's plate tuning condenser is

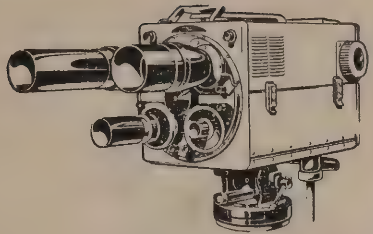


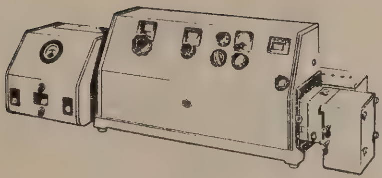
Circuit of the EL37 stage. There are two errors in the parts values. (1) The 100 *uuf.* coupling condensers to the plate tank should be 0.001 *uf.*, and (2) the 150 *uuf.* fixed tuning condensers should be 250 *uuf.* The coil is 2 in. in diameter, and has 18 turns of 16-gauge, spaced one wire diameter. The fixed output link has three turns wound over the main coil, and insulated with sheet celluloid, or perspex.

tuned throughout its range. The chances are that a setting will be found where quite strong oscillation takes place at the frequency of the signal. This can be checked with the previously set wavemeter, and if signal oscillation is found, the plate tank condenser is tuned to the point that gives the *strongest* oscillation. Everything is then turned off and the neutralizing condensers are then made and installed.

The neutralizing condensers consist of nothing more than a few turns of bare tinned copper wire, wound over a piece of P.V.C.—insulated hook-up wire. Theoretically, the required neutralizing capacity should have been 2 $\mu\mu$f., but in practice, the capacities used were found to be each 1 $\mu\mu$f. only. The best way to neutralize the stage is simply to adjust the condensers until it no longer oscillates. This may seem a rather hit-and-miss procedure, but with a Class A stage like this one, it works very well, because if there is no load on the plate tank circuit, and the latter is tuned to resonance, only a very slight amount of feedback is required for the stage to oscillate, on account of the high voltage gain under these conditions. The best plan is to put on, say, five turns of wire to make the neutralizing condensers in the first place; they are then installed, and pieces about an eighth of an inch long are snipped from the tinned wire at a time, the stage being tested for neutralization at each trial. Eventually, a point will be reached where no oscillation takes place, even when the plate tank condenser is in resonance with the modulator tank. The stage can then be reckoned to be neutralized. In the original, it was found that at a spot considerably away from plate circuit resonance with the input circuit, an oscillation took place that was quite unaffected by the neutralization. This behaviour indicated a parasitic, and, sure enough, when the circuit was explored with the absorption wavemeter, a quite strong oscillation was found, taking place at about 150 mc/sec. This could certainly have been cured by inserting a 150 mc/sec. R.F. choke in one of the grid leads, but as it was found that the oscillation disappeared when the stage was loaded, no further notice was taken of it.

(Continued on Page 33.)





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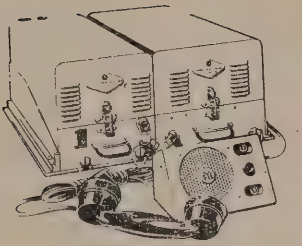
It is over fifty years since the Pye Company was founded in Cambridge. Here you can see a few of the products which the Pye Company of today has designed and manufactured for the modern world.



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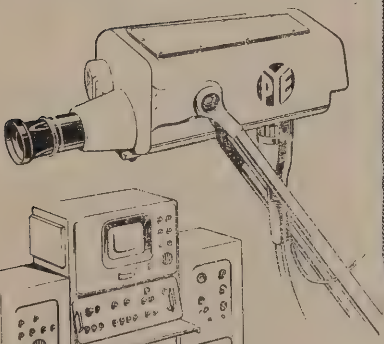

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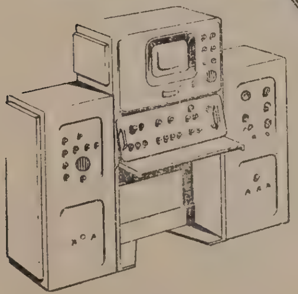


PYE Radio and Television

PYE (NEW ZEALAND) LIMITED, P.O. BOX 2839, AUCKLAND

For the Serviceman—H.M.V. Model 467S.B.

ELECTRICAL SPECIFICATIONS

Frequency Ranges:
"Standard Broadcast" (A) .... 550–1,650 kc/sec.
"Short Wave" (B) .... 5.75–18.5 mc/sec.

Bandspread:
"19 Metres" (C) .... 15–15.5 mc/sec.
"25 Metres" (D) .... 11.5–12.1 mc/sec.
"31 Metres" (E) .... 9.5–9.8 mc/sec.

Alignment Frequencies:
Band "A" .... 600 kc/sec., 1,400 kc/sec.
Band "B" .... 6 mc/sec., 18 mc/sec.
Band "C" .... 15 mc/sec., 15.5 mc/sec.
Band "D" .... 11.5 mc/sec., 12 mc/sec.
Band "E" .... 9.5 mc/sec., 9.8 mc/sec.
Intermediate Frequency .... 455 kc/sec.

Valve Complement:
(1) 6U7-G .... R.F. Amplifier
(2) 6K8-GT .... First Det.-Oscillator
(3) 6U7-G .... Intermediate Amp.
(4) DH-63 .... Second Det., A.F. Amp. & A.V.C.
(5) KT63 .... Audio Power Amp.
(6) 6X5-GT .... Full-wave Rectifier
(7) 6U5 .... Tuning Indicator

Power Supply Rating .... 230 Volts, 50 Cycles

R.F. TRIMMER ADJUSTMENTS

"Broadcast"

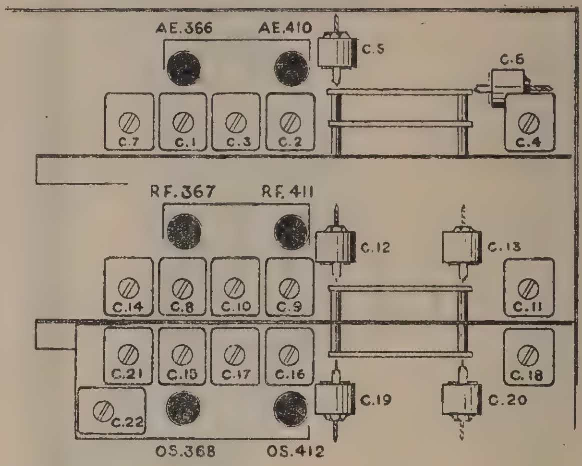
(a) Attach the output of the test oscillator to the receiver aerial through a 200 $\mu\mu$f. condenser. The ground terminals remain connected together. Check the pointer adjustment by setting it to a point where it is just visible at the high frequency end of the dial (three-gang condenser fully out of mesh). The output indicator should be left connected to the system. Adjust both the test oscillator and the dial pointer to 1,400 kc/sec. Leave the volume control of the receiver at its maximum positon. Make sure that the wave-change switch is in the Band "A" position. Carefully align the oscillator, R.F. and aerial trimmers C.21, 14 and 7 respectively, so that each brings about maximum indicated receiver output. During all adjustments, care should be taken that the test oscillator output is kept as low as is practicable. (b) Shift the test oscillator to 600 kc/sec. and tune the receiver to pick up this signal, then, disregarding the dial reading at which it is best received, rock the tuning control backward and forward through the signal, simultaneously adjusting the oscillator padder C.22 for maximum receiver output. After completing this adjustment the trimmers C.21, 14 and 7 should be re-aligned as in (a) to correct any change brought about by the adjustment of C.22.

"Short Wave"

Adjust the test oscillator to 18 mc/sec. and set the receiver tuning control to a dial reading of 18 mc/sec. Make sure that the wave-change switch is in the Band "B" position. Adjust the trimmers C.18, 11 and 4 of the oscillator, R.F. and aerial coils, so that each produces maximum receiver output. Two positions of maximum will be found with the trimmer C.18. The one of minimum capacitance is correct and should be used. This can be checked by tuning the "image" signal, which will be received twice the I.F. frequency (910 kc/sec.) away (i.e. at 17.09 mc/sec. on dial). Now adjust the test oscillator to 6 mc/sec. and tune the receiver. With no further alignment the dial reading should correspond.

"Spreadbands"

It will be necessary to repeat the following alignment procedure several times before exact alignment is obtained. Trimmers C.20, 13 and 6 are common to all three of the bands, but will give maximum receiver output on all bands if the receiver is correctly aligned.



Band "E" (31 Metres)

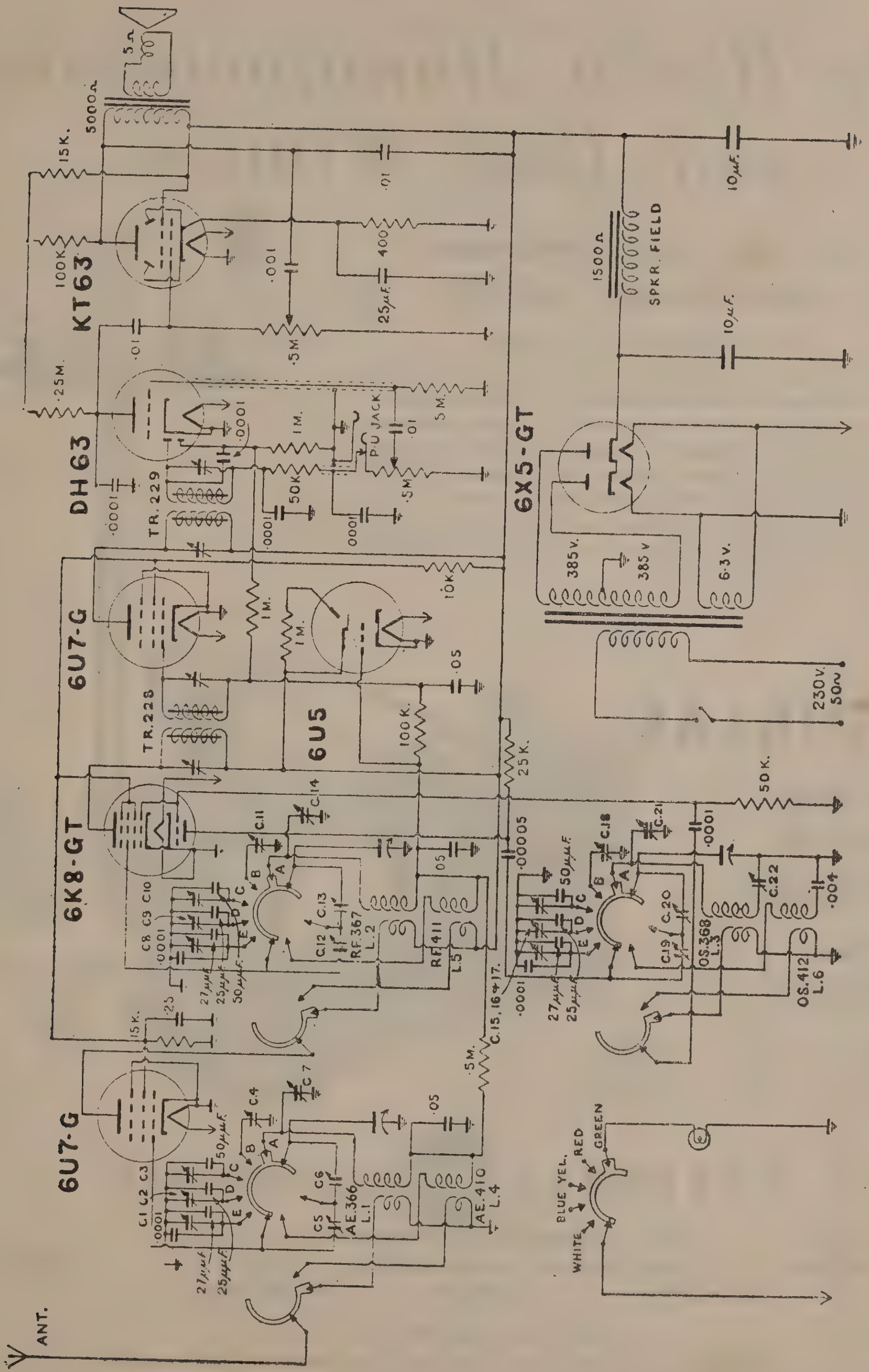
Adjust the test oscillator to 9.8 mc/sec. and set the receiver tuning control to a dial reading of 9.8 mc/sec. Make sure that the wave-change switch is in the Band "E" position. Adjust the trimmers C.15, 8 and 1 for maximum receiver output. Now tune both the test oscillator and the reeciver to 9.5 mc/sec. and adjust C.20 (the "spreading" condenser) for maximum signal. Shift the receiver pointer to a point somewhere in the middle of the band and adjust C.13 and C.6 for maximum output, using either the signal generator, a station or general noise.

Band "D" (25 Metres)

Adjust the test oscillator to 12 mc/sec. and set the receiver tuning control to a dial reading of 12 mc/sec. Ensure that the wave-change switch is in the Band "D" position. Adjust the trimmers C.16, 9 and 2 for maximum receiver output. Now tune both the test oscillator and the receiver to 11.5 mc/sec. and adjust C.20 again for maximum receiver output. The setting of this condenser should be very nearly the same as the setting for maximum signal in the alignment of Band "E." With the receiver pointer at a point somewhere in the middle of the band adjust C.13 and C.6 again for maximum output.

Band "C" (19 Metres)

Adjust the test oscillctor to 15.5 mc/sec. and set the receiver tuning control to a dial reading of 15.5 mc/sec. The wave-change switch should now be in the Band "C" position. Adjust the trimmers C.17, 10 and 3 for maximum receiver output. Now tune the test oscillator and the receiver to 15 mc/sec. and adjust C.19 (the "spread" condenser) for maximum signal. With the receiver pointer somewhere in the middle of the band adjust C.12 and C.5 for maximum output, again using either the signal generator, a station, or general noise as an indication.


KT63
DH63
6U7-G
6U5
6K8-GT
6U7-G
6X5-GT
TR.229
TR.228
P.U JACK
SPKR. FIELD
1500Ω
5000Ω
385 V.
385 V
6·3 V.
230 V.
50~
10μF.
AE.366
L.1
AE.410
L.4
RF.367
L.2
RF.411
L.5
OS.368
L.3
OS.412
L.6
C.15, 16+17.
BLUE YEL.
RED
GREEN
WHITE
ANT.

TUBE DATA—The 2E26 V.H.F. Beam Power Amplifier

The 2E26 is a beam power amplifier intended primarily for use in F.M. transmitters, either in low power driver stages, or in the output stage when only low power output is required. It is also useful in A.F. power and modulator service.

Having high power sensitivity and high efficiency, the 2E26 can be operated at relatively low plate voltage to give large power output with small driving power. Furthermore, it can be operated with full input to 125 megacycles.

Small in size for its power output capability, the 2E26 features rugged button-stem construction with short internal leads, and an octal base with short metal sleeve which shields the input to the tube so completely that no other external shielding is required. Separation of input and output circuits is accomplished by bringing the plate lead out of the bulb to a cap opposite the base.

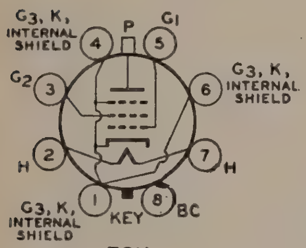
Grid—No. 2 input	2.5 max.	watts
Peak heater-cathode voltage:		
Heater negative with respect to cathode	100 max.	volts
Heater positive with respect to cathode	100 max.	volts
Typical Operation:		
D.C. plate voltage	250	volts
D.C. grid—No. 2 voltage	160	volts
D.C. grid—No. 1 (control grid) voltage	—12	volts
Peak A.F. Grid—No. 1 voltage	12	volts
Zero-signal D.C. plate current	35	ma.
Max.-signal D.C. plate current	42	ma
Zero-signal D.C. grid—No. 2 current	7	ma.
Max.-signal D.C. grid—No. 2 current	10	ma.
Load resistance	5500	ohms
Total harmonic distortion	10	per cent.
Power output	5.3	watts
Maximum Circuit Values:		
Grid—No. 1— Circuit resistance	30000 max.	ohms

PUSH-PULL A.F. POWER AMPLIFIER AND MODULATOR CLASS AB2*

Values are for two tubes

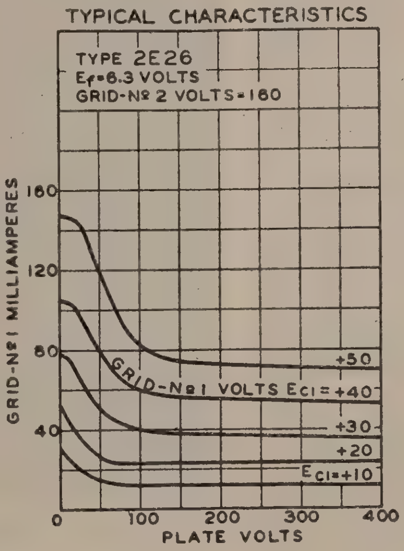
Maximum Ratings, *Absolute Values*:

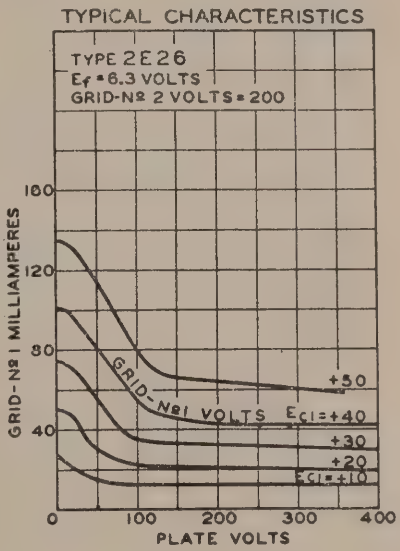
SOCKET CONNECTIONS
Bottom View



7CK

PIN 1: CATHODE, GRID NO.3, INTERNAL SHIELD
PIN 2: HEATER
PIN 3: GRID NO.2
PIN 4: SAME AS PIN 1
PIN 5: GRID NO. 1
PIN 6: SAME AS PIN 1
PIN 7: HEATER
PIN 8: BASE SLEEVE
CAP: PLATE





GENERAL DATA

Electrical

Heater, for unipotential cathode:		
Voltage (A.C. or D.C.)	6.3	volts
Current	0.8	ampere
Transconductance for plate current of 20 ma.	3500	micromhos
Grid-screen Mu-Factor	6.5	
Direct inter-electrode capacitances°		
Grid to plate	0.20 max	uuf.
Input	13	uuf.
Output	7	uuf.

°With no external shield and base sleeve connected to ground.

Mechanical

Mounting Position	Any
Overall length	3½ in. ± 5/32 in.
Seated length	2 15/16 in. ± 5/32 in.
Maximum diameter	1 5/16 in
Bulb	T-9
Cap	Small
Base	Small wafer octal 8-pin with sleeve No. R-6159

A.F. POWER AMPLIFIER AND MODULATOR—CLASS A1

Maximum Ratings, *Absolute Values*:

	CCS†	
D.C. plate voltage	300 max.	volts
D.C. grid—No. 2 (Screen) Voltage	200 max.	volts
Plate dissipation	10 max.	watts

	C.C.S.†	I.C.A.S.†	
D.C. plate voltage	400 max.	500 max.	volts
D.C. grid—No. 2 (screen) voltage	200 max.	200 max.	volts
Max.-signal D.C. plate current**	150 max.	150 max.	ma.
Max.-signal plate input**	60 max.	75 max.	watts
Max.-signal grid—No. 2 input**	5.0 max.	5.0 max.	watts
Plate dissipation**	20 max.	25 max.	watts
Peak heater-cathode voltage:			
Heater negative with respect to cathode	100 max.	100 max.	volts
Heater positive with respect to cathode	100 max.	100 max.	volts
Typical Operation:			
D.C. plate voltage	400	500	volts
D.C. grid —No. 2 voltage†‡	125	125	volts
D.C. Grid—No. 1 voltage (fixed bias)	—15	—15	volts
Peak A.F. Grid—No. 1—to Grid—No. 1 voltage	60	60	volts
Zero-signal D.C. plate current	20	22	ma.
Max.-signal D.C. plate current	150	150	ma.
Max.-signal D.C. grid—No. 2 current	32	32	ma.
Effective load resistance (plate to plate)	6200	8000	ohms
Max.-sig. driving power (approx.)§	0.36	0.36	watt
Max.-signal power output (approx.)	42	54	watts

PLATE-MODULATED R.F. POWER AMPLIFIER—CLASS C TELEPHONY

Carrier conditions per tube for use with a maximum modulation factor of 1.0

Maximum Ratings, *Absolute Values*:

	C.C.S.†	I.C.A.S.†	
D.C. plate voltage	400 max.	500 max.	volts
D.C. grid—No. 2 (screen) voltage	200 max.	200 max.	volts
D.C. grid—No. 1 (control grid) voltage	—175 max.	—175 max.	volts
D.C. plate current	60 max.	60 max.	ma.
D.C. grid—No. 1 current	3.5 max.	3.5 max.	ma.
Plate input	20 max.	27 max.	watts
Grid—No. 2 input	1.7 max.	2.3 max.	watts
Plate dissipation	6.7 max.	9 max.	watts
Peak heater-cathode voltage:			
Heater negative with respect to cathode	100 max.	100 max.	volts
Heater positive with respect to cathode	100 max.	100 max.	volts
Typical Operation:			
D.C. plate voltage	400	500	volts
D.C. Grid—No. 2 voltage¶	160	180	volts
	32000	35500	ohms
D.C. Grid—No. 1 Voltage●	—50	—50	volts
	20000	20000	ohms
Peak R.F.—Grid No. 1 voltage	60	60	volts
D.C. plate current	50	54	ma.
D.C. grid—No. 2 current	7.5	9	ma.
D.C. grid—No. 1 current (approx.)	2.5	2.5	ma.
Driving power (approx.)	0.15	0.15	watt
Power output (approx.)	13.5	18	watts
Maximum Circuit Values:			
Grid—No. 1—Circuit Resistance●●	30000 max.	30000 max.	ohms

R.F. POWER AMPLIFIER AND OSCILLATOR—CLASS C TELEGRAPHY

Key-down conditions per tube without modulation¶¶

Maximum Ratings, *Absolute Values*:

	C.C.S.†	I.C.A.S.†	
D.C. plate voltage	500 max.	600 max.	volts
D.C. grid—No. 2 (screen) voltage	200 max.	200 max.	volts
D.C. grid—No. 1 (control grid) voltage	—175 max.	—175 max.	volts
D.C. plate current	75 max.	75 max.	ma.
D.C. grid—No. 1 current	3.5 max.	3.5 max.	ma.
Plate input	30 max.	40 max.	watts
Grid—No. 2 input	2.5 max.	2.5 max.	watts
Plate dissipation	10 max.	13.5 max.	watts
Peak heater-cathode voltage:			
Heater negative with respect to cathode	100 max.	100 max.	volts
Heater positive with respect to cathode	100 max.	100 max.	volts

Typical Operation:

D.C. plate voltage	400	500	600	volts
D.C. Grid—No. 2 voltage§§	190	185	185	volts
	19000	28500	41500	ohms
D.C. Grid—No. 1 voltage††	—30	—40	—45	volts
	10000	13500	15000	ohms
Peak R.F. grid—No. 1 voltage	41	50	57	volts
D.C. plate current	75	60	66	ma.
D.C. grid—No. 2 current	11	11	10	ma.
D.C. grid—No. 1 current (approx.)	3	3	3	ma.
Driving power (approx.)	0.12	0.15	0.17	watt
Power output (approx.)	20	20	27	watts

Maximum circuit values:

Grid—No. 1—circuit res.●● 30000 max. 30000 max. ohms

†C.C.S. = Continuous Commercial Service: I.C.A.S. = Intermittent Commercial and Amateur Service.

*Subscript 2 indicates that grid current flows during some part of input cycle.

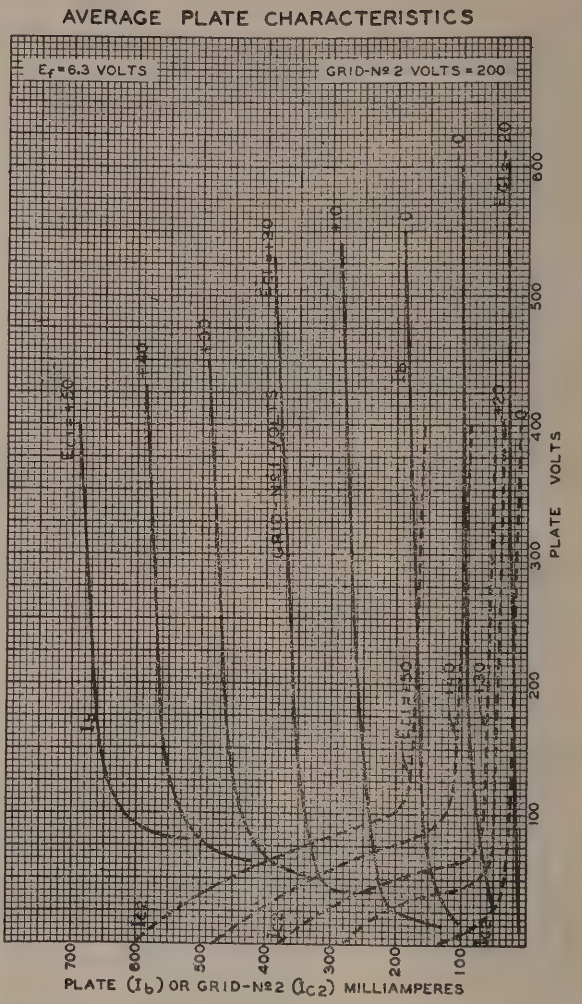
**Averaged over any audio-frequency cycle of sine-wave form.

†Preferably obtained from a separate source, or from the plate-voltage supply with a voltage divider.

‡In applications requiring the use of screen voltages above 135 volts, provision should be made for the adjustment of grid No. 1 bias for each tube separately.

The necessity for this adjustment at the lower screen voltages depends on the distortion requirements and on whether the plate-dissipation rating is exceeded at zero-signal plate current.

§Driver stage should be capable of supplying the No. 1 grids of the class AB2 stage with the specified driving power at low distortion. The effective resistance per No. 1 grid circuit of the class AB2 stage should be kept below 500 ohms and the effective impedance at the highest desired response frequency should not exceed 700 ohms.



¶Obtained preferably from a separate source modulated with the plate supply, or from the modulated plate-supply through series resistor of the value shown.

●Obtained from grid resistor of value shown or by partial self-bias methods.

●●Any additional bias required must be supplied by a cathode resistor or a fixed supply.

¶¶Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115 per cent. of the carrier conditions.

§§Obtained preferably from a separate source, or from the plate-voltage supply with a voltage divider, or through a series resistor of the value shown. The grid No. 2 voltage must not exceed 600 volts under key-up conditions.

††Obtained from fixed supply, or by grid No. 1 resistor of value shown.

BACK NUMBERS OF "R. & E."

Back numbers are available from:—

Te Aro Book Depot, Courtenay Pl., Wellington.
S.O.S. Radio, Ltd., 283 Queen Street, Auckland.
S.O.S. Radio, Ltd., 1 Ward Street, Hamilton.
Tricity House, 209 Manchester St., Christchurch.
Ken's Newsagency, 133-135 Stuart St., Dunedin.

Philips Experimenter

(Continued from Page 25.)

FINAL ADJUSTMENT AND OPERATION

Once the amplifier has been neutralized, there is not very much involved in putting it on the air. There is not likely to be any difficulty about obtaining the correct operating bias, since the stage is cathode-biased, so that this can be disregarded. The next most important factor is the plate loading, and the data already given indicates that the plate-to-plate load should be 4000 ohms. The only question is, how does one tell when the aerial is loading the final tank to the tune of 4000 ohms. Well, for initial testing, the aerial does not come into the matter, because the testing should be done on a dummy load. For this purpose, a resistor, or combination of resistors totalling this figure should be connected straight across the plate tank circuit. If one has an R.F. milliammeter, it will be a help to connect this in series with the load resistor, but if the output is being observed on a 'scope, it is only necessary if it is desired to measure the actual power output after adjustment is complete. The power rating of the resistor should be about 20 watts, particularly if the full output is to be applied for more than a few moments at a time. However, as long as the full output is kept on only for short periods, a much smaller resistor will do. A pair of 2000-ohm 1-watt resistors will even do if one does not mind burning them up in the process!

When a single audio tone, such as 400 or 1000 c/sec., is fed to the audio input of the exciter, the R.F. output of the modulators consists of a single radio frequency, so that an examination of the amplifier's output will reveal nothing more interesting than a band of light across the screen of the C.R.T. As the audio input is increased, the amplitude of the R.F. output should increase in exact proportion, until the overload point of the R.F. amplifier is reached. Unfortunately, this does not enable an accurate estimate of the overload point to be made, because it is not possible to see the individual cycles of the R.F., in order to judge whether or not they are distorted. In order to overcome this difficulty, what is known as a "two-tone signal" is used. This signal can be produced by feeding two audio tones into the exciter, and when this is done, a beat pattern becomes visible, very similar, but not identical with a modulated R.F. pattern. With this pattern on the screen, the amplitude varies between zero and full output, at a rate equal to the difference in frequency between the two tones. If the oscilloscope time-base is synchronized with this beat frequency, the pattern will become stationary, and it will be possible to observe the peaks and valleys.

TWO OSCILLATORS NOT NECESSARY

Fortunately, it is not necessary to have two audio oscillators in order to produce the two-tone signal. In our case we have only to remove the audio input to one of the balanced modulators. When this is done, the output consists of a double-sideband, suppressed carrier signal, and this clearly consists of two R.F. tones, differing in frequency by twice the audio frequency that is being used. The 'scope pattern is therefore identical with that obtained by using two audio oscillators. To get the two-tone pattern, all we have to do is to turn R_{27} right off, so that no audio is delivered to the lower balanced modulator.

USE OF THE TWO-TONE PATTERN

The audio input control is advanced slowly, and the growth of the pattern is watched. It will simply get larger and larger, until the peaks, which at low amplitudes have a perfect sine-wave shape, start to flatten off. The process is exactly similar to watching on a 'scope the overloading of an audio amplifier. The input control is then turned down until the pattern has just ceased to overload, and is left there. A piece of cellophane tape is used to mark the position of peak amplitude, and then, without altering the audio input, R_{27} is advanced. When this is done, the valleys in the pattern start to fill in, but it will be noticed that the peaks stay at the same amplitude. R_{27} is turned up until the valleys just disappear; when this happens, adjustment is complete. In our own case, it was found that the voltage right across the plate tank was too much, over-filling the screen, so the Y plates were connected to the ends of the coupling link, giving a pattern on a 6 in. tube about 2½ in. high. It will be noted that adjustment in the manner described, also gives a final pattern showing the maximum residual modulation, as was described in the paragraphs on setting up the exciter.

It is useful and instructive, while the adjustment is going on, to listen to the output of the amplifier on the absorption wavemeter. With the two-tone pattern at full amplitude, the beat produced in the detector by the two R.F. tones is heard very loudly, but as the unwanted sideband is gradually removed by turning up R_{27}, the tone gets progressively weaker, until, at the right setting, as shown up by the oscilloscope, it disappears almost entirely, leaving only the very rough note of the remaining modulation, which is only entirely absent in the case of a theoretically perfect system. Do not be concerned if these spurious modulation products sound very loud in the headphones of the absorption meter, because their loudness cannot be compared with that of the proper signal at all, since an absorption meter has no oscillator which can beat with the output to reproduce the modulation. If the meter could be made by some miraculous means to demodulate the output of the amplifier when it is held in the same position where the spurious modulation products give a loud signal, the true signal would almost literally blow the listener's head off!

After having seen some of the horrible-looking two-tone patterns that the books state are obtained from a linear amplifier that is improperly neutralized, or else has the wrong operating conditions, we were very agreeably surprised to see the theoretically perfect pattern on the screen, at the first attempt, and there is no reason at all why those who have been following this series should not do the same.

When the 'scope has been used to set up the unit on a dummy load, the maximum output at the link terminals should be noted on the 'scope. Then, with the aerial tuner connected to the output terminals, and adjusted to resonance with very loose coupling, the coupling can be increased until the 'scope pattern is the same size as it was with the dummy load. The load on the amplifier by the aerial is now the same as was given by the 4000-ohm resistor, and all that remains is to talk into the microphone, just loudly enough for the output amplitude to hit the previously-found mark on the speech peaks.

A FINE RECORD!

Mr. A. Wyness retires from the Managing Directorship of His Master's Voice (N.Z.) Ltd.

Contented New Zealanders, who talk glibly and familiarly about celebrated overseas entertainers, probably don't realize the debt of gratitude they owe to Mr. Alfred Wyness.

For Mr. Wyness, who retired recently from the position of Managing Director of H.M.V. (N.Z.), Ltd., has probably done more than almost any other man to bring the voices of great people to the ears of the people of this Dominion.

For the retiring Managing Director, however, there is, despite his comparative anonymity, consolation in the fact that H.M.V. has become a familiar name in radio and electrical appliances; and that H.M.V. gramophone records and discs by Decca, Regal-Zonophone, Columbia, and other world-famous companies handled in New Zealand by H.M.V., are sought alike by everyone from bobby-soxers to dowagers.

Mr. Wyness has been associated with the industry almost since its inception in New Zealand and almost since he, himself, arrived in the Dominion from Scotland.

He reached New Zealand in 1904 and joined the company of Joseph Nathan & Co., Ltd., at their dried milk factory in Bunnythorpe. He resigned through ill-health, however, and joined Aitken Wilson & Co., studying accountancy while employed there. He became a member of the N.Z. Accountants' Society and of the Incorporated Institute of Accountants of New Zealand.

In 1910 he joined E. J. Hyams Ltd., as Secretary, soon after the company had been granted the New Zealand agency for H.M.V. products. At this time the main Australasian agency was in Sydney, but the development of the New Zealand trade made it possible, by 1918, for New Zealand to be granted direct representation.

In that year a separate subsidiary of the company was established to handle H.M.V. products. It operated under the name of Gramophonium Ltd., which remained until 1926, when His Master's Voice (N.Z.) Ltd., was registered as a separate company with its own directors and capital. Mr. Hyams, Mr. Wyness, and Mr. W. Manson, who came from England to establish a factory in Sydney, were the three Directors, but, when Mr. Hyams withdrew in 1930, Mr. Wyness became Managing Director of the company.

Now, after more than two decades in the control of the company during its most formative period, Mr. Wyness can look back from retirement on an amazingly successful development in the company's affairs.

Soon after he took control of the organization—a post conferred on him by the Directors of the parent company in England—Mr. Wyness found two conflicting and important factors in the radio and gramophone business. First, the almost fantastic development of radio as a new entertainment medium for almost the whole of the people; and secondly, a falling away in record sales as radio stations were established . . . and more people bought radio sets.

The company immediately established a radio department and radios were imported in constantly-increasing numbers from Britain and America.

At the same time, new agencies were established with overseas record producing companies—and before long the company was handling not only H.M.V. and Zonophone discs, but Columbia and Regal as well. Later came the amalgamation of Regal and Zonophone into what is now the well-known Regal-Zonophone brand. Later still, came the taking over of the distribution of Parlophone records, giving the company the bulk of the record-distributing business in the Dominion; and bringing virtually all of the world's best-known artists to the New Zealand people.

Mr. A. Wyness, retiring Director, photographed with his son, Mr. A. J. Wyness, who will be his successor.

Meanwhile, during the thirties, another side of the business was developing—the distribution of refrigerators, washing-machines, ironers, domestic irons, toasters, and other household appliances. This development brought even greater expansion to the firm's already considerable business.

Until 1938, the company was largely an importing organization, but in that year import restrictions caused the stoppage of many of them and a severe restriction in the importing of others. Thus, a further forward move was made with the establishment of a manufacturing plant.

Troubles, as any philosopher knows, can never come singly. And, as the factory was beginning to operate smoothly, war developed and the manufacture of domestic radios and appliances had to give way to war production. Instead of radio receivers for use in the home, the company began to manufacture radio transmitters for the

armed forces and other war equipment made under strict supervision from the Government.

And during the production of one of the types of armed forces radio units, the H.M.V. factory established a production record for the whole of the radio-producing factories in the Dominion.

At the end of the war, the factory reverted to the production of commercial models of radio receivers and made up the leeway in production lost during the war. Simultaneously, the demand for radios in the Auckland

Mr. E. J. Hyams, Managing Director of E. J. Hyams Ltd.

district was increasing tremendously and it was decided to establish an Auckland branch, to which Mr. E. J. Isaac was appointed as Manager.

In the meantime, the demand for new discs was increasing as music-lovers sought new records almost in vain. Licence control of imported records meant they were not supplied with the discs they wanted and a factory was established in Kilbirnie, Wellington, where overseas discs were pressed locally from imported matrices. Production of these records was soon stepped up to 50,000 a month.

Yet another milestone may be reached by the company with the installation of additional presses at Kilbirnie and up-to-date studios, where recordings may be made by local artists.

Space during the last few years has been a constant problem to the company so that in 1950 the company decided to buy a block of land, with buildings, in Wakefield Street, Wellington. Large-scale alterations were

Mr. and Mrs. A. Wyness photographed with Mrs. A. J. Wyness.

made and the company's Head Office and departments were installed in new, spacious quarters.

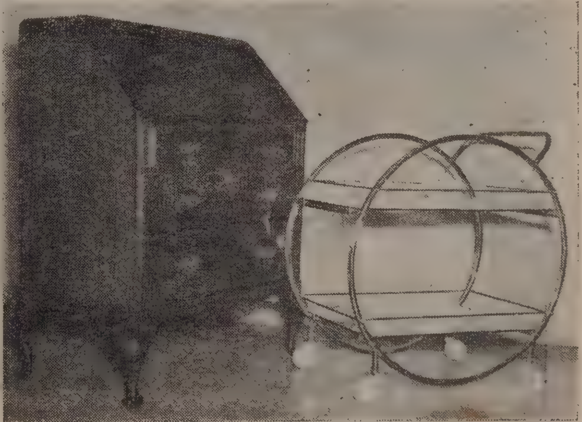
Mr. Wyness, therefore, has left the company in a secure position from every viewpoint. The company is

Mr. J. McGregor and Mr. L. Southward exhibiting a replica of the famous Listening Dog Trade Mark.

established as an integral part of New Zealand business, playing an important part in the commercial entertainment, educational, and cultural life of the people. Mr. Wyness is succeeded by his son, Mr. Jack Wyness, who, growing up with the business, has held important executive posts since early in his career.

The work of Mr. Wyness and tributes to his contribution to the development of the industry, were recalled at Wellington recently when a large number of friends and business associates met to farewell him.

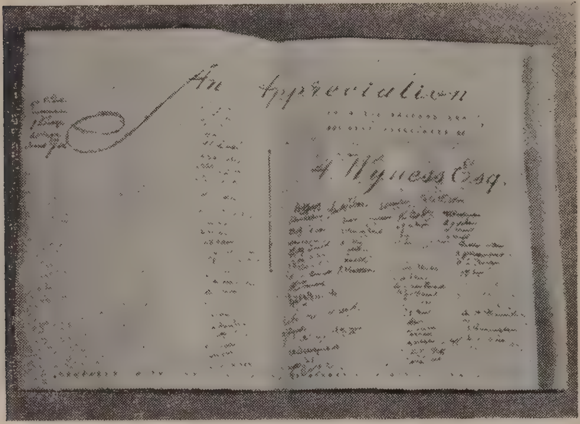
One of the principal speakers at the function—held at Wellington's Royal Oak Hotel—was Mr. Hyams who recalled his early association with Mr. Wyness and paid tribute to his ability in building the large industrial



Presentations from H.M.V. dealers made to Mr. and Mrs. A. Wyness.

organization from a small indent business. Other speakers included Mr. J. Sutcliffe, who spoke in appreciation on behalf of radio dealers, and the Hon. R. McKeen, a former Speaker of the House of Representatives. Gifts of a writing bureau to Mr. Wyness and a tea trolley and china to Mrs. Wyness, were made by Mr. Murray Wiseman on behalf of H.M.V. dealers throughout New

Zealand; and Mr. R. Bull, on behalf of the senior executive and staff of H.M.V. (N.Z.), Ltd., presented Mr. Wyness with a clock.



The special "Appreciation Memento" signatured by all who attended the farewell dinner.

Telegrams, cables, and letters were received from Sir Alexander Aikman, C.I.E., Chairman of Directors, Electric and Musical Industries Limited, England; Sir Ernest Fisk, Hon. M.I.E.E., Hon. M.Brit.I.R.E., F.Inst. R.E. (U.S.A.), M.I.E. (Aust.), F.Inst.R.E. (Aust.), Deputy-Chairman and Managing-Director E.M.I. Ltd.;

The Chef's contribution to the celebrations—an ice cream cake in the form of a "Little Nipper" radio!

L. J. Brown, Comptroller of Electric and Musical Industries Limited; Mr. A. T. Lack, late Managing-Director, Overseas Interests Department, E.M.I. Ltd.; Mr. L. T. Dines, Manager, same company; Mr. A. H. Saville, Overseas Interests Department, Mr. J. M. Burnett, Managing Director, E.M.I. (Aust.) Pty. Limited, Mr. G. Still, E.M.I. Supplies Ltd., Mr. R. Slade, President, Wellington Radio Manufacturers' Association, and New Zealand Radio Manufacturers' Federation; Mr. W. Clarke, Managing Director, H. W. Clarke Ltd., and many others.

Mr. Wyness, who, besides heading the affairs of H.M.V. over the years, has found time to be president of the U.K. Manufacturers and N.Z. Representatives' Association for a period, and a member of the Wellington Harbour Board during the war years, replied to the good wishes of those who spoke at the function.

His son, in a brief address, said he had accepted a big responsibility. He felt that with the co-operation of the staff with which he was proud to be associated, the name of the company would be carried on with honour to its founder in New Zealand.

Mr. Alfred Wyness, despite the severance of his active connection with the company as its Managing Director, will share a part in its role in the future as Chairman of Directors—a post he will not relinquish.—Published by Arrangement.

N.Z. Radio Trader's Association Notes

AUCKLAND

TELEVISION TRAINING COURSE

The proposed course in television training, organization of which has been sponsored by the Auckland Provincial Radio Traders' Association, has now become an accomplished fact. At the Seddon Memorial Technical College, Wellesley Street East, Auckland, a new laboratory has been established, equipped to give thorough practical as well as theoretical training. No doubt, members will feel some pride in the knowledge that Auckland now leads the way in TV training with a set-up which not only makes tuition in practically every branch of electronics easily available to anyone interested, but moreover such training is free of cost in most cases, or can be obtained for a very nominal fee in others.

Night classes have already commenced, and any further applicants for the course should contact Mr. R. B. Waddell, who is in charge of electronics training at the college. The enrolment fee is 5s. 6d.

Annual fees at the college vary according to age and the amount of free post-primary education already received. For those who have received only three years free post-primary education the charge will be nil, for those with only four years of such education there will be no fee for the first year and only a nominal charge for the second year. For those who have had five years free post-primary education already but are still under 21, the annual fee is £1, and for those 21 and over, the fee is £2 per annum.

WELLINGTON

A meeting was held on February 11th, 1952, during which a report of the Membership Committee was discussed. Considerable success has attended the efforts of the sub-committee, which has been responsible for increasing our membership to 61. The next meeting of the Association will be held in April prior to the Annual Conference of the Federation, which will take place in Dunedin on May 14th.

Apprenticeship Matters

A New Zealand Radio Apprenticeship Committee has been registered, the first meeting having taken place last December. The initial function of the committee is to prepare an Apprenticeship Order, but in view of the numerous problems that will have to be settled, it is unlikely that this function will be completed for some time.

Proceedings of the New Zealand Electronics Institute Incorporated.

HEADQUARTERS NEWS

Rutherford Memorial Fund

Advice has been received that a further meeting of the committee responsible for the Wellington District appeal was held recently. Reports received stated that the total sum donated for New Zealand as at the end of 1951 was £6,000, £1,000 of which was from Wellington. The Wellington total now, however, stood at approximately £1,500. Various publicity measures were discussed at the meeting and arrangements made to hold a further meeting very shortly.

Amendments to Rules

At the next meeting of the Executive Council consideration is to be given to a proposal to amend the rules with respect to the status of members. It is hoped that full publicity regarding this matter will be available following the meeting.

Branch Activities

Towards the close of last year the Wellington Branch Committee discussed a proposed "Gadgets Evening" and it was arranged that the committee should arrange for the delivery of one paper at the forthcoming July and August meetings respectively since this would assist the incoming committee when taking office.

The last meeting for the year took the form of a "Short Papers and Discussion" evening, Mr. Dippy opening with a brief dissertation on types of oscillators, referring to the sponge-locked oscillator used in early radar. Questions were asked of Mr. Dippy, and Mr. Salmon and Mr. Gabriel give circuits and short talks on other types of R.C. oscillators.

Due to the fact that quite a number of our members are on annual leave, branch activity during the summer months is necessarily restricted and consequently Institute Proceedings are of a brief nature.

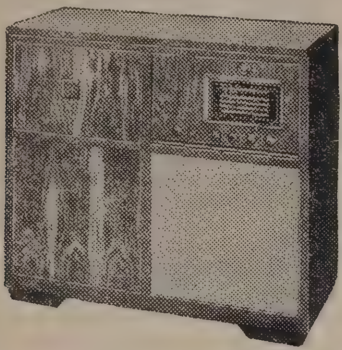
Institute Awards

The Committee responsible for considering the above matter has yet to submit its report to Council and it is hoped that when this matter is finally implemented there will be several excellent papers available for printing in these Proceedings.

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. Advertising rates are charged according to space occupied. For further particulars contact Advertising Manager, R. and E., Box 8022, Wellington.

ULTMATE 8-VALVE ALL-WAVE LOWBOY



The imaginative craftsmanship of this superb cabinet exemplifies the best of contemporary design. The gramophone unit of this new Ultimate production is mounted in a pull-out drawer above a record cupboard of generous proportions. A large baffle area in fawn coloured grille cloth offsets the darker toned figured walnut veneers.

The new Ultimate receiver is highly selective and powerful and incorporates the latest in radio design. There is bandspreading on short-wave.

Those who are tone-conscious will appreciate the popular pentonic tone control which gives five positions of tone ranging from treble to high fidelity.

Equipped with 12 in. auditorium speaker this magnificent new Ultimate instrument represents the acme of modern craftsmanship and should be a delight to the connoisseur of fine music.

Specifications:

Dimensions: Height, 33 in.; width, 37 in.; depth, 16 in., excluding cabinet handles.

Mains consumption: 60 watts.

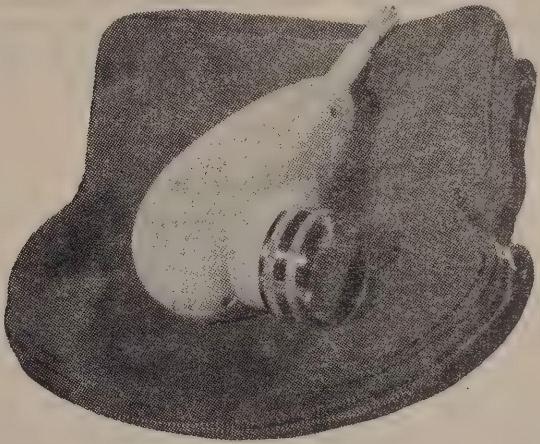
Gramophone unit: Plessey 3-speed auto-changer.
Price: £135 10s. retail.

* * *

PHILIPS "BEAUTIPHIL" ELECTRIC RAZOR

New on the market in New Zealand, but used extensively overseas, the Philips "Beautiphil" is the perfect jewel of an electric razor, especially created for the ladies. It removes superfluous hair from legs and underarms quickly, closely, without pull or burn. The "Beautiphil" can't cut, nick, or scratch because it is designed with a special circular head to fit underarm contours and leg surfaces—and it doesn't get blunt. In an attractive cream plastic and chrome finish and supplied with its own suede-like zip-up case, Philips "Beautiphil" will delight any feminine heart.

The "Beautiphil" was developed in the Laboratories of Philips in the Netherlands where the world-famous "Philishave" electric dry-shaver for men originated. Like the "Philisave", it has a self-starting real brush-type motor, thus avoiding troublesome pitting of contact points always encountered in make-and-break vibrator units. This rotary electric motor runs cooler, makes less noise, operates more efficiently and stays out of the repair shop. Bearings are self-lubricating. The six cutters



within the rotary cutter head slice hairs like a straight razor rather than "pinching" them. And as the cutters whirl against the guard, they sharpen themselves. The radial slots in the round head are designed to gather all hairs, long or short, coarse or fine no matter what their direction of growth. In every case it leaves the skin beautifully smooth and in perfect condition.

In addition to its depilatory use in milady's toilet, the "Beautiphil" is unexcelled for hospital operating theatres where quick efficient hair removal is important.

"SILENT ELECTRIX" CLEANER

Made under licence to Electrix Ltd., Dagenham, Essex,

England, by New Zealand Dominion Radio and Electrical Corporation, Ltd., Auckland, is the "Silent Electrix" vacuum cleanner pictured here. Operated under A.C. or D.C. mains 230/250 volts and employing 1/5th h.p. motor the current consumption is 1.5 amperes. This new cleaner incorporates a deodorizing and air purifying

(Continued on page 40.)

system and the numerous accessories make this an all-in-all cleaner.

Of the conventional barrel type design, the "Silent Electrix" has some improved streamlined features over earlier barrel types. Of all-steel construction, it is generously supplied with heavy chromium plate on all metal parts ensuring durability and lasting finish.

Other special features of this cleaner are: Pressure-cast aluminium runners of patented type designed for following the operator upstairs as required, an extra large easy-to-remove dust-bag, completely rubber-floated motor unit for noise-free operation, cast type swivel carpet nozzle covering a surface of 27 inches, built-in radio and television noise suppressor, foot-operated switch ,treble suction-end seal, and single release-end caps.

Russell Import Co., Ltd., Wellington, are the distributors and they say of this cleaner "Good to look at and as good as it looks."

* * *

Book Review

"Foundations of Wireless," by M. G. Scroggie, B.Sc., M.I.E.E., Fifth Edition. Published on November 16th, 1951, for "Wireless World" by Iliffe and Sons, Limited. Price 12s. 6d. (postage 8d.). Size 8¾ in. x 5½ in., 328 pages, 236 illustrations. Linson binding with jacket.

First published in 1936, "Foundations of Wireless" has long since become established as a classic in its field, and scores of thousands have gained their first acquaintance with the principles of radio transmission and reception from its pages. This fifth edition has been entirely rewritten and is illustrated with over 200 new diagrams. The whole basic theory of radio is covered, starting with the most elementary principles. No previous technical knowledge whatever on the part of the reader is assumed, mathematics eschewed except where essential, and the book is written in Mr. Scroggie's well known, lucid, and frequently humorous style.

Apart from the fundamental laws of electricity and radio, the theory of valves, transmitters, and all types of modern receivers is described, and there is an introduction to the techniques of television and radar, while aerials, power supplies, and transmission lines are also dealt with.

A feature of special interest to the beginner is the introductory section which explains fully the use of algebraic symbols, graphs, and circuit diagrams. Equally valuable is the comprehensive system of indexing and cross-referencing, enabling the reader to find any information (and particularly the meaning of both British and American technical terms) without difficulty.

The continuing heavy demand over the years for "Foundations of Wireless" has demonstrated its remarkable success. It provides the perfect introduction to the study of radio in all its branches.

CONTENTS:

Preface—Initiation: Into the Shorthand of Wireless—A General View—Elementary Electrical Notions—Capacitance—Inductance—Alternating Currents—Capacitance in A.C. Circuits—Inductance in A.C. Circuits—The Tuned Circuit—Valves: The Simpler Types—Oscillation—The Sender—Radiation and Aerials—Detection—The Single-Valve Receiver: Reaction—Radio-frequency Amplification: Screened Valves—Selectivity—The Superheterodyne Receiver—Audio-frequency Circuits—Power Supplies—Cathode-ray Tubes—Transmission Lines—Appendix—Index.

Missing or Stolen Radios

The following reports have been received by the N.Z. Radio Traders' Federation, and should any member of the Federation or other reader have any knowledge of the present whereabouts of any of this radio equipment, he is asked to communicate with the nearest police station.

Auckland Provincial Radio Traders' Association

"Autocrat" tuning unit only, serial number 3937. Brown metal case, grey escutcheon. As this unit is of no value without the speaker unit, inquiries among dealers may give a lead to the persons responsible for the removal of this tuning unit.

Police Station, Putaruru

One Pacemaker, portable, battery set, about 14 in. x 10 in., handle on top, back of set has been unscrewed and left; reddish brown colour; dirty mark around white material round speaker; non-standard control knobs; valued at £25. No. 819 A.B. 84206, identifiable by number.

District Police Office, Dunedin

Alleged to have been pillaged from the motor vessel m.v. *Karu* some time between 30/11/51 and 5/12/51, whilst vessel working cargo at ports in this Dominion.

Six "Pacemaker" portable radio sets, Serial Nos. 98132, 98350, 98136, 98458, 98356, and 98478. All bakelite cases, combination A.C./D.C. with dry batteries. Four black coloured cases, one burgundy, and one silk oak. Radios valued at £23/12/3 each.

Two 5-valve dual-wave mantel model "Pacemaker" radio sets, Serial Nos. 3577 and 3579, in bakelite cases red and dark oak in colour. Each valued at £14/14/-.

One "Cromwell" radio set, 5-valve dual-wave, Serial No. 3476, contained in walnut coloured bakelite case, and valued at £14/14/-.

Stolen from the premises of Crichton's Refrigeration Ltd., 298 George Street, Dunedin, between 18/1/52 and 20/1/52:—

"Bell" portable 4-valve radio, dark brown, with bakelite case, round shaped dial with a scroll over the face, 12 in. x 6 in. x 6 in. Serial No. either 1183 or 1166, valued at £26/5/-.

"Bell" Ensign Radio No. 1046, dark brown with bakelite case, round shaped dial, 12 in. x 6 in. x 6 in., 4-valve, valued at £18/18/-.

Trade Winds

POPE VALVES

The Swan Electric Company Ltd. announce their appointment as the sole New Zealand distributors of Pope Valves, manufactured by N. V. Pope's Draad-en-Lampenfabreinken of Holland. The Pope Company is a very old established firm and the "Pope" brand, although new to New Zealand, is very well known on the Continent of Europe. Pope manufacture a complete range of valves of all types and for every purpose, including the latest miniature and novel types. Their products are of the highest quality and will be a welcome addition to the brands already on this market.

The Swan Electric Company Limited advise that they will be stocking, in their six branches, the entire range of replacement types, and that initial supplies are now in hand.

* * *

For three days in February the various branches of Philips Electrical Industries of N.Z. Ltd. were left with only meagre staffs, while field representatives from all branches met at Head Office for a general "get-together" on sales and service matters. This time, branch managers were left at their posts to cope with general business routine. For Philips, this "get-together" is a new innovation, and no doubt will provide many new angles for discussion at the next managers' conference.

* * *

During February, Les Wright, Manager of H.M.V. (N.Z.) Ltd., Wellington, spent a week in Sydney making contacts with H.M.V. associates, especially those engaged on radio and recording activities.

* * *

Continuing their policy of expansion, the Grover Electrical Co., Ltd., has recently opened new branches at 103–105 Hobson Street, Auckland, and at 2 Pitt Street, Palmerston North.

Just prior to Christmas a very enjoyable opening function took place at their Palmerston North premises, and this was attended by all sections of the electrical trade. Mr. Howard Hening, late of Messrs. Arnold and Wright, Ltd., Wellington, is managing the Auckland branch.

* * *

If rumour is correct, the New Zealand Broadcasting Service is not to be the sole possessor of a brand new recording van, for we understand that a Hamilton firm shortly proposes to introduce an ultra-modern four-wheel trailer, complete with magnetic tape recorders, disc recorders and P.A. amplifiers, etc., together with a 3 kw. electric generating set.

* * *

Undoubtedly the biggest man in radio to visit New Zealand is Dick van Amstel, whose 6 feet 7½ inches compels him to duck his head when passing through most doorways.

Mr. van Amstel, who is the Manager of Philips Electrical Industries factories in Australia, is making an extensive holiday tour of New Zealand accompanied by his charming wife. Mr. and Mrs. van Amstel originally intended to spend their holiday in the Commonwealth but after hearing the glowing reports of New Zealand from Mr. F. J. Philips, who visited this country shortly before Christmas, they decided to alter their plans and see for themselves.

While here Mr. van Amstel will also confer with the Management of Philips, New Zealand, on production problems which are common to the Philips New Zealand and Australian factories.

* * *

Ralph Slade, Commercial Manager of Philips Electrical Industries, recently spent a fortnight touring the South Island on a "busman's holiday." Ralph, who is a well-known personality throughout New Zealand, reports that he renewed many old friendships but regrets that time was too short to visit the number of people he would like to have seen.

Publications Received

Sylvania News (September, October, and November, 1951), from Sylvania Electric Products Inc. (G. A. Wooller & Co., Ltd.).

Plessey Pub. No. Z 1457 "London through the Pages of 'Picture Post,'" Plessey International Ltd., England. (Swan Electric Co. Ltd.)

Aerovox Research Worker, September, 1951—Aerovox Corporation. U.S.A.

"Recorded Music 1951", Catalogue of Recorded Music—from The Gramophone Co., Ltd., England. (H.M.V. (N.Z.), Ltd.)

"Radiotronics," January, 1952—Amalgamated Wireless Valve Co., Pty., Ltd.

Philips Technical Review, December, 1950, January to May, 1951—N. V. Philips Gloeilampenfabrieken, The Netherlands. (Philips Electrical Industries (N.Z.), Ltd.)

Folder "Precision Sapphire Needle"—S. E. Brown Ltd., England. (Russell Import Co., Ltd.)

Brochure "Long Playing"—The Decca Record Co., Ltd., England. (Russell Import Co., Ltd.)

Leaflets, Courtenay "Rodney" and "Albatross"—Turnbull and Jones, Ltd.

Trade Price List—Wiseman Electric Co., Ltd.

Stock List of Radio Components—Arnold and Wright, Ltd.

A recent catalogue to hand will be certain of a good welcome by both record resellers and users. We refer to the 1951 issue of "Recorded Music" issued by The Gramophone Company Ltd. (Eng.), and its associated companies, and published by the Australian house of this organization. Supplies of the catalogue are available at 2s. 6d. per copy from H.M.V. (N.Z.), Ltd., Wellington. After several pages of useful information covering a list of artists, pronunciation guide, gramophone needles, points of importance, etc., there is a catalogue of approximately 270 pages of English records, and 125 pages of Australian recordings by "H.M.V." Columbia, Decca, Parlophone, M.G.M. A wealth of information for a modest 2s. 6d.!

FOR SALE.—One ZC1 Mark II with headphones and two microphones. Price £20. Apply H. Green, 1013 Gordon Road, Hastings.

FOR SALE—Tape-recorder, 2-speed, as new. What offers? "Record," c/o "Radio and Electronics."

Latest Record Releases

(Supplied through the courtesy of Messrs. H.M.V. (N.Z.), Ltd.)

ORCHESTRAL:

L'Arlesienne Suit No. 2 (Bizet), Philharmonia Orchestra conducted by Sir Malcolm Sargent. Col. DX 1605/6.

Die Fledermaus—Overture (Johann Strauss): Philharmonia Orchestra conducted by Josef Krips. Col. DX 1707.

Sleeping Beauty—Ballet Music (Tchaikovsky): Leopold Stokowski conducting his Symphony Orchestra. H.M.V. DB. 9499/9504 (Set. A. 112).

Invitation to the Dance (Weber orch. Berlioz): Philharmonia Orchestra conducted by Igor Markevitch. H.M.V. C. 4018.

Peter and the Wolf (A musical tale for children (Prokofieff)); Philharmonia Orchestra conducted by Igor Markevitch, Narrator, Wilfred Pickles. H.M.V. C. 7816/8.

Capriccio Italien (Tchaikovsky): Danish State Radio Symphony Orchestra conducted by Nicolai Malko. H.M.V. C. 7846/7.

Simple Symphony (Britten, 5 parts) Boyd Neel String Orchestra. Fuge in A Minor (Bach. arr. Nicholson). Decca AX. 245/7.

CONCERTOS:

Concerto for Basson in F. Op. 75 (Weber): Gwydion Brooke, Bassoonist, with Liverpool Philharmonic Orchestra conducted by Sir Malcolm Sargent. Col. DX. 1656/7.

INSTRUMENTAL:

Jesu, Joy of Man's Desiring (Bach. arr. Hess); Siciliana (from Sonata No. 2 in E Flat for Flute and Cembalo) (Bach) Dinu Lipatti, Pianist. Col. LB. 109.

Prelude in C Sharp Minor (Rachmaninoff); Minuet in G Paderewski): Jose Iturbi, Pianist. H.M.V. DB. 6468.

Sonata No. 1 in B Minor (Bach): Yehudi Menuhin, Violinist and Louis Kentner, Pianist. H.M.V. D.B. 9607/8.

Noel No. 10 (Daquin); Toccata, "Tu Es Petra" (Mulet): Fernando Germani, Organist, recorded in Westminster Cathedral. H.M.V. C. 3928.

Fantaisie-Impromptu in C Sharp Minor (Chopin); Waltz No. 1 in E Flat, Op. 18 (Chopin): Halina Stefanska, Pianist. H.M.V. C. 3968.

OPERATIC AND LIGHT OPERATIC:

Lohengrin, Act 3 (Wagner)—Introduction; Bridal Chorus: (Sung in German) Vienna Philharmonic Orchestra and Vienna State Opera Chorus, conducted by Herbert Von Karajan. Col. LX. 1360.

Faust—Jewel Song (Gounod) (sung in French): Gypsy Baron—Saffi's Aria (Strauss) (sung in German) Maria Cebotari, soprano, with Vienna Philharmonic Orchestra. H.M.V. DB. 6947.

The Yeomen of the Guard (Gilbert and Sullivan): D'Oyly Carte Opera Company. Decca AK. 2415/25 Set. D. 25.)

VOCAL:

Cantata No. 51—Jauchzet Gott (Praise Ye God) (Bach) (5 parts); Cantata No. 68—Mein glaubiges Herz (My Heart Ever Faithful) (Sung in German) (Bach) Elisabeth Schwarzkopf, Soprano, with Philharmonia Orchestra, Organ and Trumpet. Col. LX. 8756/8.

Jubilate Deo (for eight voices) (Gabrieli): Danish State Broadcasting Madrigal Choir conducted by Mogens Woldike. Col. DDX. 20.

Maria Wiegenlied (The Virgin's Slumber Song) (Reger) (sung in German); Solveig's Song (from "Peer Gynt") (Greig) (sung in Italian): Rina Gigli, Soprano with Royal Opera House Orchestra. H.M.V. DB. 6931.

Boris Godounov—Pimen's Monologue (Still One More Page) (Moussorsgsky) (sung in Russian) Boris Christoff, Bass, with Philharmonia Orchestra. H.M.V. DA. 1938.

Away in a Manger; The First Nowell: Unto Us a Boy is Born: Shepherds in the Field Abiding: The Templars, Male Voice Choir with George Thalben-Ball at the Organ. H.M.V. C. 4039.

The Twelve Days of Christmas: See Amid the Winter's Snow: O Little Town of Bethlehem: The Templars, Male Voice Choir with George Thalben-Ball at the Organ. H.M.V. B. 9995.

Vorrei, Spiegarvi, Oh Dio! Oh Conte, Partite (Recit. and Aria) (Mozart) (sung in Italian): Maria Stader, Soprano, with Orchestra and Oboe Obbligato. H.M.V. C. 4056.

Pokare Kare Ana (Maori Folk Song): De Blanca Tierra (Inca Song from Bolivia) Eu Vou M'embora (Brazilian Embolada): Quebra O Coco Menina (Brazilian Coco): Ola Coelho, Soprano with Guitar. Parl. RO. 20593.

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